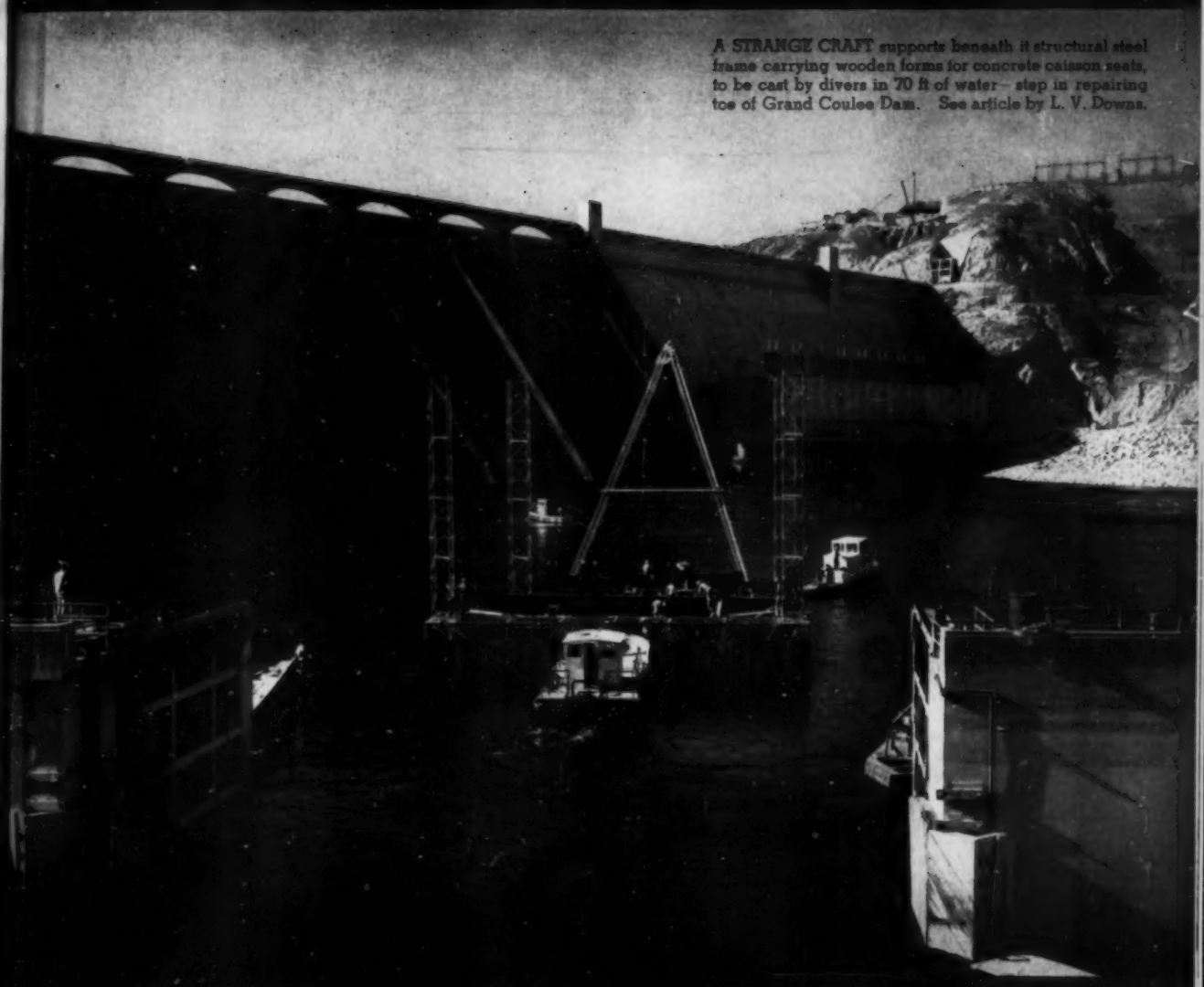
APRIL 1950

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION



A STRANGE CRAFT supports beneath it structural steel frame carrying wooden forms for concrete caisson seats, to be cast by divers in 70 ft of water – step in repairing toe of Grand Coulee Dam. See article by L. V. Downs.

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

New York Constructs New-Type Refuse Incinerator—Zurmuhlen

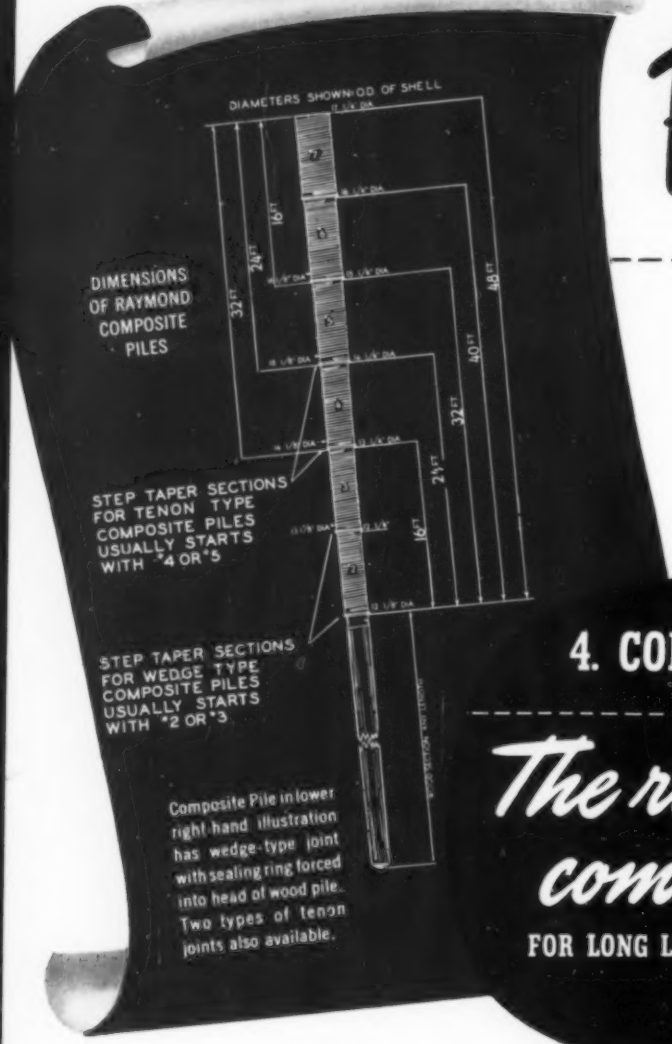
Unique Concrete Shipway Built at Newport News, Va.—FitzHugh and Irvine

Attend Spring Meeting in Los Angeles, Calif.—April 26-29, 1950

Raymond MAKES 5 TYPES OF CONCRETE PILES

1. STANDARD . . . 2. STEP-TAPER . . .
3. PIPE STEP-TAPER . . . 4. COMPOSITE
5. GOW CAISSONS

Raymond installs every type of pile: cast-in-place concrete, precast concrete, steel pipe, wood and H-beam. Raymond operations include underpinning, borings and soil investigations; waterfront construction and harbor and river improvements; also cement mortar lining of pipes by the Centriline Corporation, a Raymond Subsidiary.

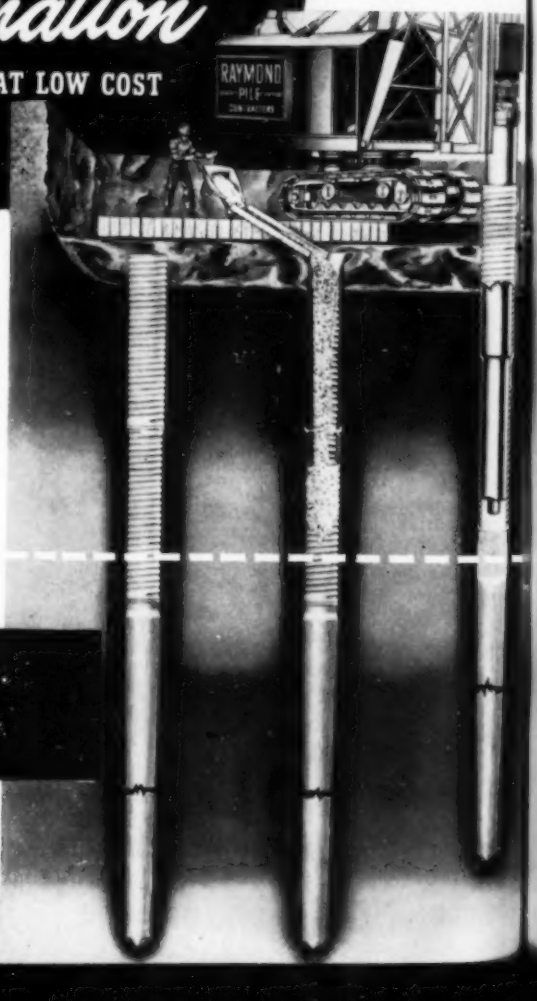

DIAMETERS SHOWN O.D. OF SHELL
DIMENSIONS OF RAYMOND COMPOSITE PILES
STEP TAPER SECTIONS FOR TENON TYPE COMPOSITE PILES USUALLY STARTS WITH #4 OR #5
STEP TAPER SECTIONS FOR WEDGE TYPE COMPOSITE PILES USUALLY STARTS WITH #2 OR #3
Composite Pile in lower right-hand illustration has wedge-type joint with sealing ring forced into head of wood pile. Two types of tenon joints also available.

4. COMPOSITE PILES

The right combination

FOR LONG LENGTH AT LOW COST

Right, driven wood pile is being followed down by pile shell of concrete section. Center, completed pile driven to resistance, pile shell is being filled with concrete. Joint, wedge-type with sealing ring, is below ground-water level. Completed pile is shown at left.



Raymond Composite Piles are used for economy and long length (up to 140 feet). The concrete upper section extends from the permanent water table up to the underside of the footing, thus eliminating the expensive excavation, sheeting and pumping often required with wood piles.

Raymond Composite Piles have solved many deep foundation problems permanently and at minimum final cost. We shall be glad to advise you, without obligation, whether they are suitable for your project.

PERMANENT WATER LINE

RAYMOND PILES MAINTAIN DRIVING RESISTANCE

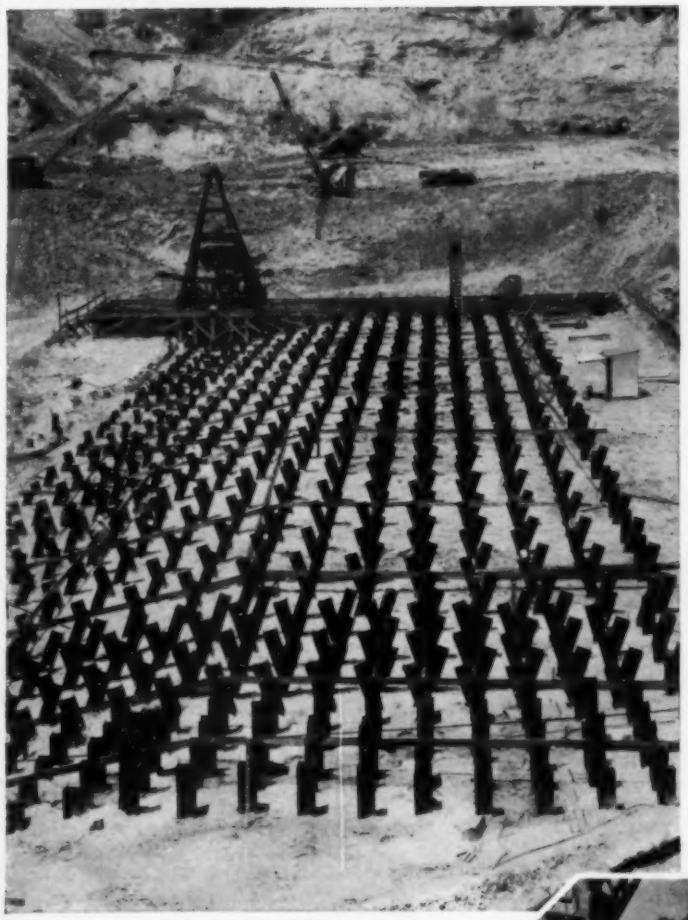
Raymond CONCRETE PILE CO.

140 CEDAR STREET, NEW YORK 6, N. Y.

BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America.

2127

Steel H-Beam Bearing Piles support huge spillway for Dam "B" near Jasper, Texas



DAM "B" is located on the Neches River, near Jasper, in the piney hills of East Texas. As a unit of the four-dam Neches-Angelina Rivers project, Dam "B" will provide a reservoir which will regulate the fluctuating outflows from the power plants of the proposed McGee Bend and Rockland reservoir projects.

Construction of the concrete spillway section necessitated re-routing of the Neches River, excavation of 225,000 cubic yards of material and construction of a foundation of 53-pound steel H-Beam bearing piles.

These U·S·S Bearing Piles, CBP Section-124, are spaced at 5-foot centers in the spillway structure, at 3½ foot centers in the wing walls, and at 8-foot centers in the stilling basin area, driven into hard packed clay with a 19,000 foot-pound hammer.

The gates of Dam "B" will close in December of 1950, with the entire project expected to be completed in 1952.

This dam foundation is one of many nationally important foundation jobs in which both economical and practical considerations are better served by U·S·S Steel Bearing Piles and U·S·S Steel Sheet Piling. Let us show you how these service-tested construction products can be used to solve your problems most efficiently. For complete details, call the United States Steel office nearest you, or write to United States Steel, 2135 Carnegie Building, Pittsburgh 30, Pennsylvania.

(Above) Piling in the main part of the structure consists of alternate rows of batter piling, up-stream and down-stream three-to-one, to sustain lateral load and prevent sliding. Straight vertical pilings are used in the stilling basin.

(At right) Driving sections of U·S·S MP-102 Steel Sheet Piling along the up- and down-stream limits of the concrete spillway structure to prevent seepage under the concrete portion of the dam. The up-stream sections are 32 feet long, down-stream, 26 feet long.

Construction is under the direction of Lt. Colonel Ellsworth I. Davis, District Engineer, U. S. Army Corps of Engineers, Galveston, and under the immediate supervision of Fred W. Johnson, Resident Engineer. The gated spillway will be built by Reynolds & Williams and Noonan Construction Company, G. E. Murphey, Superintendent.

USS

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH · COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

STEEL H-BEAM BEARING PILES

0-374

UNITED STATES STEEL

CIVIL ENGINEERING, April, 1950. Vol. 20, No. 4. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

Without crushing strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life !

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

SERVES FOR CENTURIES

RICHMOND HAS IT... Over all!

Over the entire field of concrete construction, Richmond has developed the right form-tying devices for every requirement . . . for faster form-erection; quicker form-stripping; and a cleaner, more accurate job. Rely on Richmond for soundly engineered products . . . and the technical know-how which comes from the widest experience in the field.

RICHMOND SNAP-TYS

Made in required lengths, to break off flush or at specified depths up to 2"—for safe loads to 3000 lbs. Four standard and several special types to cover every condition. A family of 30 products.

RICHMOND TY-SCRUS

Available in specified lengths, 2 or 4 struts, for safe loads to 30,000 lbs. Standard and adjustable types cover every requirement and every condition. Serve as reanchorage after use as tie. A family of 45 products.

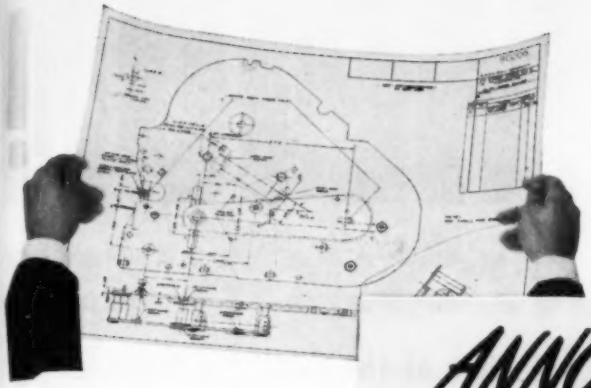
These are just a few of the many items in the Richmond family. Send for catalogue for complete line.

RICHMOND TYLOOPS & RICHMOND SCREW ANCHORS

A versatile duo with various functions. Use Tyloops as rugged cantilever or lift-from anchorage for safe loads to 30,000 lbs. In length, style and strength as required. Richmond Screw Anchors for temporary Dam and Tunnel form anchorage. For Concrete Pile and Slab lifting. For permanent anchorage of Concrete Wharf Fixtures. Diameters up to 1½" and lengths as needed.

MANUFACTURERS of
ENGINEERED TYING DEVICES, ANCHORAGES
and ACCESSORIES for CONCRETE CONSTRUCTION

Kodak
TRADE-MARK

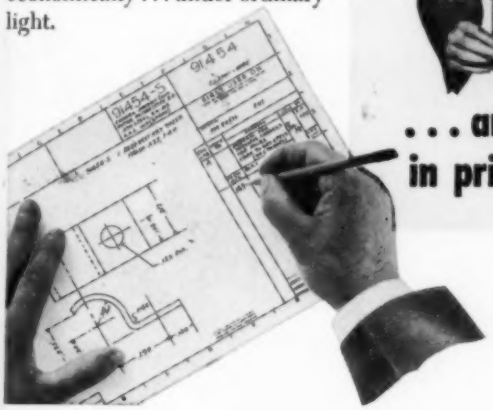


ANNOUNCING
Kodagraph Autopositive Film

1. It gives you faster printing intermediates. Now you can speed up quantity print production . . . save time and money . . . with new Kodagraph Autopositive Film! What's more, you, or your local blueprinter, can expose this amazing reproduction material in high-intensity blueprint or direct-process machines . . . or in a vacuum frame; develop it in standard photographic solutions. You get positive intermediates directly . . . and the job can be done quickly, economically . . . under ordinary light.

2. It holds detail—amazingly. Kodagraph Autopositive Film combines a high-contrast photographic emulsion and famous Kodak safety film base. It catches the finest line—keeps close lines from "filling in." Think what an aid this new intermediate material will be in producing print-making "masters" from difficult originals . . . how it can save you many thousands of dollars in redrafting costs—while assuring final prints of highest quality!

. . . and 4 new advantages in print production for you



3. It simplifies revision, reference. Both sides of Kodagraph Autopositive Film are matte-surfaced . . . can be written on with pencil or pen. And since the base is highly translucent, details can be read from either side without use of an illuminator.

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INDUSTRIAL PHOTOGRAPHIC DIVISION 93
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City_____ State_____

CHAMPION

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Here are some of the exclusive features that give the TD-24 its matchless work capacity:

1. 180-h.p. International diesel engine with gasoline-conversion starting and unmatched "lugability".

2. Synchromesh transmission for easy shift-on-the-go operation; plus eight speeds forward and eight reverse.

3. Planet Power drive, smooth and rugged, for instant speed change up or down one gear without declutching.

4. Planet Power steering to provide power on both tracks in gradual turns and permit feathered or pivot turns.

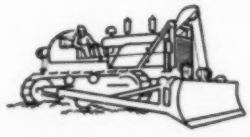
5. Separate reverse lever for quick change of direction of travel in any of the eight transmission speeds.

6. High-speed track assemblies with new recoil mechanism that holds front idlers in position against full-load track pull.

The NEW TD-24

CRAWLER TRACTORS • WHEEL TRACTORS

DIESEL ENGINES • POWER UNITS



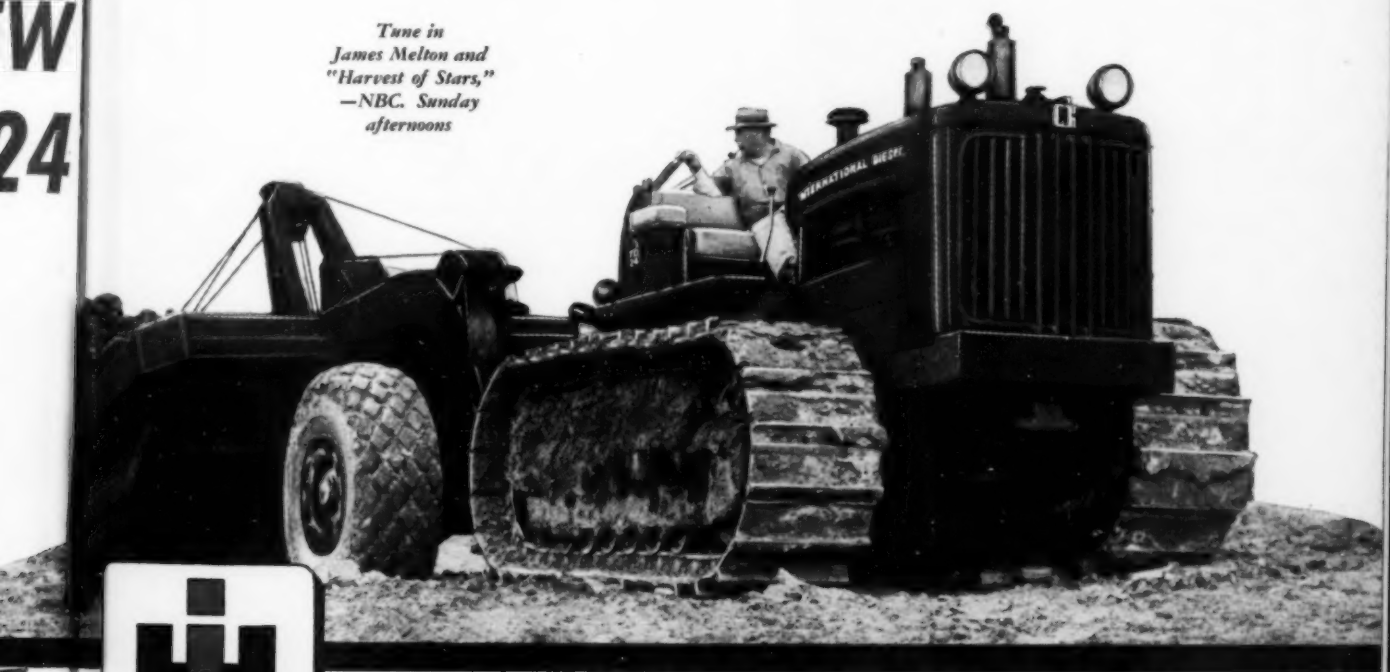
# of Crawlers

TRACTOR ON ANY JOB

● *"THE TD-24 is definitely outhauling every other tractor on the job. It will do so much work that we are sure our job costs will show a great saving!"* That's the report of the foreman on the 247,000-yd. University of Maryland stadium project. ● *"I don't have to stop on any grade,"* the operator reports, *"and we have 25% or better on this job. Why, I just go up in 4th gear easy while the other tractors have to switch to low to make it."* And the TD-24 hauls a 17-yard scraper, heaped! ● Yes, the TD-24 is the "workin'est tractor" on any job. Yet, its operator is the worker with the easiest day! See your International Industrial Power Distributor. Get a TD-24 demonstration. Discover how you, too, can save job time, cut costs, earn extra profits.

INTERNATIONAL HARVESTER COMPANY • Chicago

Tune in James Melton and "Harvest of Stars," —NBC. Sunday afternoons



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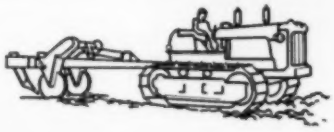


pushing the SWIFT COLUMBIA aside ... Electrically

McNary Dam Contractors depend on General Electric equipment to make a success of "the toughest river diversion ever undertaken."

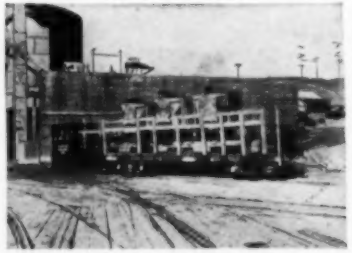
The 1953 deadline for initial generation of power at the McNary Dam project makes it an unprecedented "race against high waters." Making this deadline is a necessary step towards the alleviation of the acute power shortage in the Northwest. Because of this, the whole construction world is carefully watching the work that leads to the beginning of closure sections operations next fall. To meet this tough schedule, contractors working under contracts with the Corps of Engineers are relying on *electric drives* supplied and co-ordinated by General Electric.

Construction equipment, driven by G-E motors and control, and supplied from G-E distribution systems, will help meet your schedules with a maximum of safety, economy, and ease of maintenance. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

1. This G-E powered shovel handles 5 cubic yards of rock excavation with every bite. Operating from the 2400-volt a-c system, it responds instantly to the operator's touch; is easy to maintain despite rough usage.

5. Deep-well pumps keep leakage from flooding the construction area. The same large Tri-Clad vertical motors driving these pumps have done yeoman service for the contractors on many previous jobs.

2. Five classes of aggregate are moved from stockpiles to batch plant on belt conveyors like this. G-E motors drive and G-E controls protect these crucial links in the concreting operations at McNary.

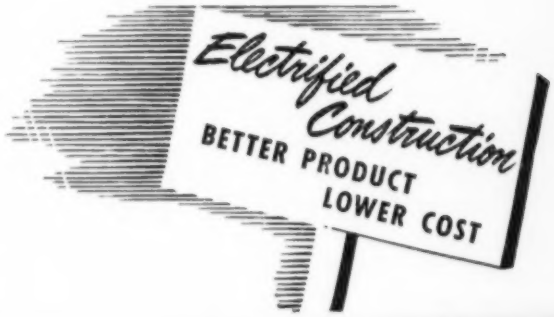


3. Four 25-ton G-E industrial locomotives (dinkies) move concrete—three 4-yard buckets at a time—from batch plant along a 675-foot wooden trestle at just the speed demanded by the schedule.

4. Two giant electrified revolving gantries remove buckets from railroad dinkies and place concrete in the world's highest single-lift navigation lock. Both cranes are driven by General Electric hoisting systems.

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.



GENERAL ELECTRIC

664-9

A GREAT GRADER!

RIGHT on the heels of rough grading on Pipestone County Highway No. 4 near Ruthton, Minn., this "Cat" Diesel No. 12 Motor Grader is finishing 9.5 miles of 30-ft. road. There's no time wasted making repeated passes – the No. 12's positive mechanical controls keep its tough blade on the beam.

John S. Pukrop, Contractor, speaks from practical experience when he says: "In my book the No. 12 is the best of all graders and most economical to operate. It has many uses, of course, but we use it for grade finishing. Two miles per 10-hour day is the average, but it could do more if the rough grade was far enough ahead. Except for two scrapers, we are 100% 'Caterpillar' owners. 'Caterpillar' machines are by far the best on the market."

Whatever the grading job, there's a "Cat" Diesel Motor Grader the right size to do it most profitably for you. And there's a responsible "Caterpillar" dealer as close as your phone for round-the-clock service. He sincerely believes this rugged yellow machine is the best in the field. Ask him for proof of its performance!

Ask your dealer for a demonstration! Ask for a showing of the new film, "Better Blading"!

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

This "Cat" Diesel No. 12 Motor Grader is one of the fleet of "Caterpillar" equipment owned by John S. Pukrop, Contractor, Ivanhoe, Minn. Other units include five D8 Tractors, two D7 Tractors, a DW10 Tractor and No. 10 Scraper.

LOOK UNDER THE HIDE

of "Cat" Diesel Motor Graders

1. Only "Caterpillar" designs and builds the entire machine. This undivided responsibility assures long life and excellent parts service.

2. Each of the 3 sizes is a completely different machine. There is no performance penalty due to excessive frame weight or too little horsepower.

3. No other graders have the dependable yellow engine famous for delivering 60-minute hours day after day.

CATERPILLAR

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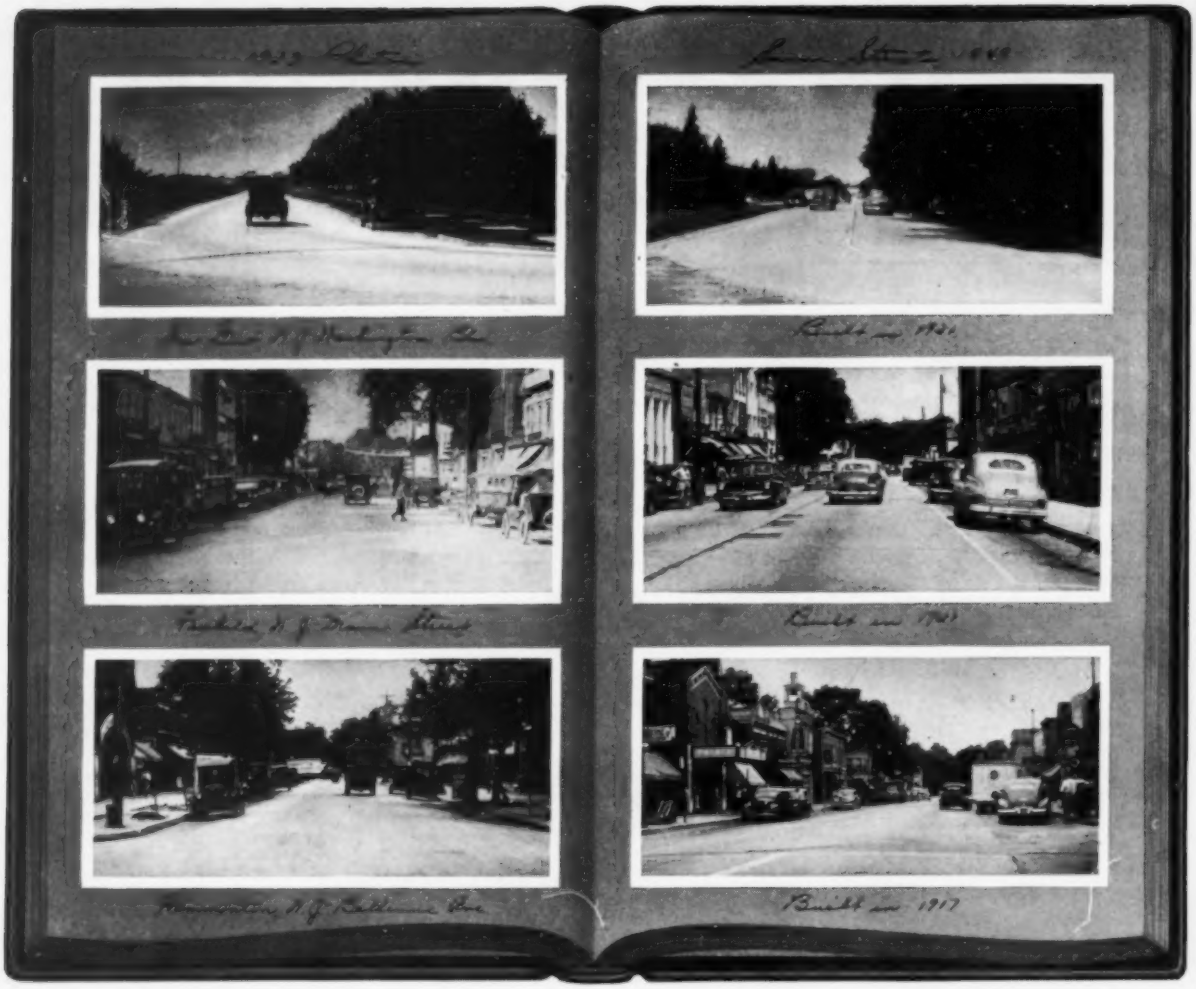
DIESEL ENGINES • TRACTORS
MOTOR GRADERS
EARTHMOVING EQUIPMENT



Here today and still here tomorrow . . . that's the story of New Jersey's CONCRETE streets

If New Jersey motorists and taxpayers kept photo albums of local streets, they would be proud of such pages as those shown above. Many of their pavements have served 30 years and more at ***low annual cost*** under traffic they were not even designed to carry.

The album above shows three of these old pavements as they appeared in 1923 and in 1949. Many other pavements such as New Jersey's first concrete street, built in 1908 in New Brunswick, and the first concrete road on Route 24 between Washington and Phillipsburg, built in 1912, are still in service. Only concrete could give such long, dependable service under ever increasing weights and volumes of traffic.

Concrete pavements not only last longer but also cost less to maintain. In New Jersey, where roads and streets carry the heaviest axle loads in the country, records show that the average annual cost of maintaining one mile of 24-ft. concrete pavement is $141. Flexible type pavements cost four times as much, or $564. Also concrete usually costs less to build than other pavements of equal load-carrying capacity. That makes concrete the real ***low-annual-cost*** pavement.

Yet these are only some of concrete's advantages. It is safer, day or night, wet or dry, because its gritty surface has uniformly high skid-resistance. Its light color provides maximum visibility at night. It keeps driving costs down by saving on fuel, tires and repairs.

For more information about ***low-annual-cost*** concrete send for a free copy of "*Concrete Pavement Design.*" Distributed only in the U.S. and Canada.

PORTLAND CEMENT ASSOCIATION

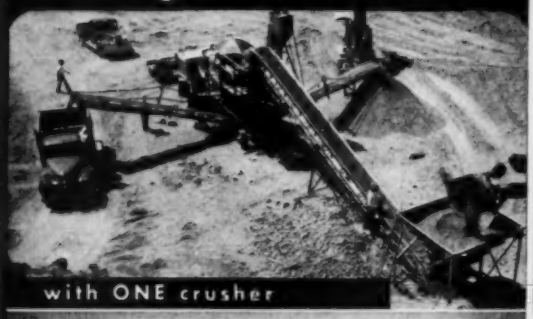
DEPT. 4-13, 33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

You Name It! We HAVE IT!

Portable (and stationary) rock and gravel crushing, screening and washing plants for every requirement. High speed jaw and roll crushers, with matching conveyors and screens, combined as you want them in a plant that will give you "More Rock for Less Money."

Single-Unit Plants



with ONE crusher

with TWO crushers

with TWO crushers

Multiple-Unit Plants

TWO units . . . TWO crushers

TWO units . . . THREE crushers

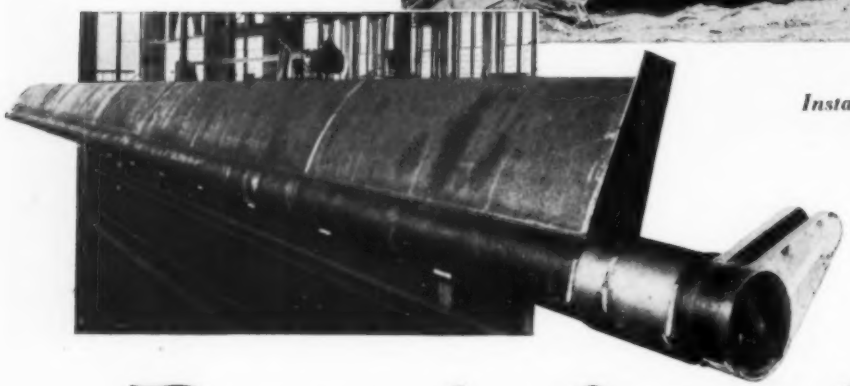
THREE units . . . FIVE crushers

Yes, whatever your particular production problem, you will find the answer in an Austin-Western plant. Our engineering department will gladly submit sketches and estimates.

AUSTIN-WESTERN COMPANY, AURORA, ILLINOIS, U. S. A.

BUILDERS OF ROAD MACHINERY SINCE 1859

Austin Western



Installation and shop views of Bascule type Crest Gates

Bascule Crest Gates *by* SMITH

Pioneering and constantly progressing, we now offer this new type gate which fills a long existing need in pond level and flood control applications. The Bascule Gate is, in essence, an automatic flash board, hydraulically or electrically operated.

This unusual gate is primarily designed and built in span and height for installations requiring greater spillway capacity or increase in pond storage above existing dam heights. Write us for data regarding our full line of gates and hoists.

S. MORGAN SMITH Co.

YORK, PENNA. U.S.A.

CLAY...

RAW STUFF OF THE *Only*

CORROSION-RESISTANT PIPE

Vitrified Clay Pipe is the only pipe offering complete protection against acids, alkalies, and chemicals. Proof? *There is no instance on record where a single length of Clay Pipe has ever worn out due to the action of a disintegrating agent.* This explains why 89% of America's sewerage lines are made of Vitrified Clay Pipe. On any sewerage or drainage project, be *sure* by specifying Vitrified Clay.

NATIONAL CLAY PIPE MANUFACTURERS, INC.

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703 Ninth & Hill Bldg., Los Angeles 15, Calif.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
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SPECIFY

Vitrified

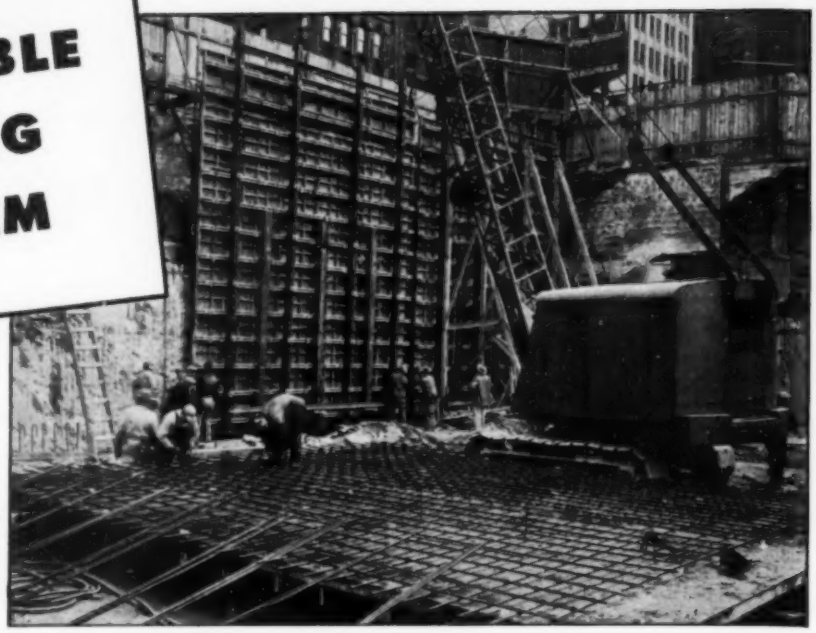
CLAY PIPE

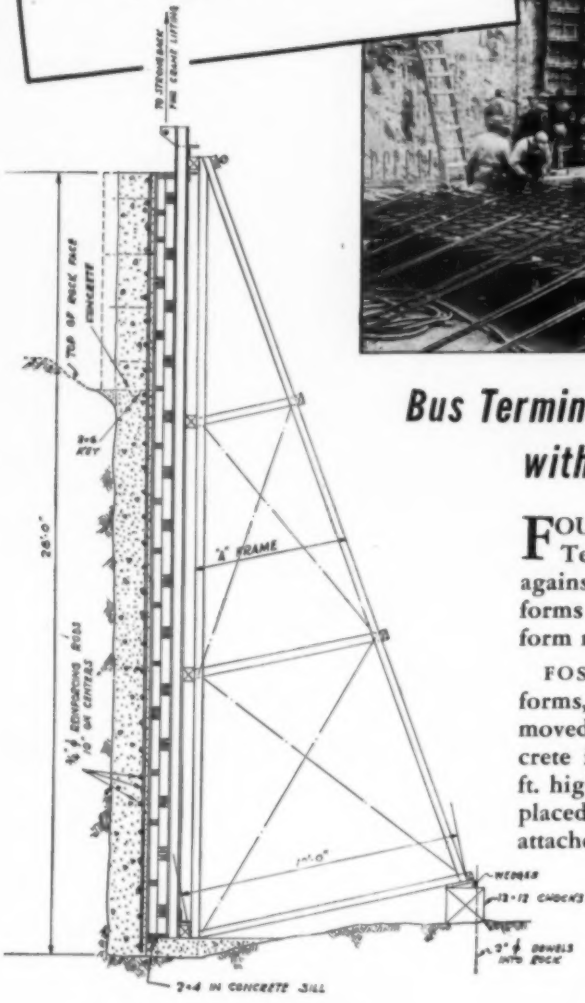
CLAY PIPE NEVER WEARS OUT!

CLAY PIPE FITTINGS | **PERFORATED CLAY PIPE** | **STANDARD-STRENGTH CLAY PIPE**

C-150-3

FORMIDABLE FORMING PROBLEM





Bus Terminal Foundation Walls Pre-assembled with Reinforcing Bars Attached

FOUNDATION walls for the New York Union Bus Terminal were concreted with one-sided forms, against a perpendicular rock face. By constructing forms on the ground, scaffolding and hoisting of form material was eliminated.

FOSS, HALLORAN & NARR, INC., assembled forms, attached rigidly-welded reinforcing steel, moved forms into position by crane, tremied concrete into place. Four form sets were used, each 28 ft. high by 24 ft. long. After stripping, forms were placed on the ground, reinforcing for next section attached, and cycle repeated.

Lone Star Cement was used on this job. Where one-day stripping is desired for faster form re-use, or in cold weather, use 'Incor',* America's FIRST high early strength Portland Cement.

* Reg. U. S. Pat. Off.

NEW YORK UNION BUS TERMINAL
8th to 9th Ave., 40th to 41st St., New York
Owner: **PORT OF NEW YORK AUTHORITY**
Lone Star Cement Ready-mix Concrete:
COLONIAL SAND & STONE CO., INC., New York
Consulting Engineer: **JACOB FELD,** New York
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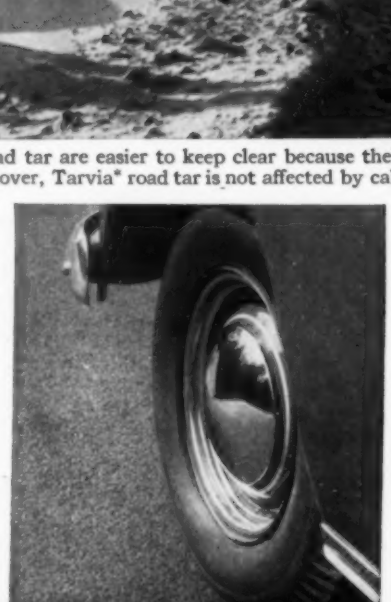

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New York Builds Incinerator With 800-Ton Daily Capacity

Betts Avenue Plant Is First of Five in 38-Million-Dollar Program

FREDERICK H. ZURMUHLEN, M. ASCE

Commissioner, Department of Public Works, New York, N. Y.

FORTY GARBAGE TRUCKS per hour, with their 3-ton loads, can enter Betts Avenue plant through street-level doorway (at extreme left in photo), dump their loads into receiving pit, and exit through door at opposite end of plant. Ash trucks have access to ash pit through depressed driveway. Two 250-ft brick stacks are designed to carry off furnace gases at flue temperature of 900 deg F and velocity of 40 fps.

DISPOSAL OF municipal refuse in New York has undergone many changes. Dumping of garbage and refuse at sea was terminated in 1934 by decree of the U.S. Supreme Court. Even with eleven incinerators now in operation, more than half the city's daily collection of 11,000 tons must be buried in sanitary fills. Long hauls to available land-fill areas, and the limited use to which these reclaimed areas can be put, influenced New York in 1946 to adopt a policy for the abandonment, by 1953, of sanitary fills in favor of incineration. The design of the four-million-dollar mechanized Betts Avenue destructor here described, was developed by engineers of the Department of Public Works, and operating tests were started this month. Refuse is fed by crane from a pit to shredders, then by mechanical drying stokers to moving burning grates. Ashes, quenched in water-filled pits, will be trucked to land-fill areas. This article is based on the paper presented at a recent joint meeting of the American Public Works Association and the Metropolitan Section of ASCE.

THE POLICY of disposing of burnable refuse in destructor plants and of abandoning the disposal of such materials in land fills as rapidly as additional incinerators can be made available was adopted by New York in 1946. This policy entailed the design by the city's Department of Public Works of five modern destructors with a combined capacity of 3,500 to 4,000 tons, the enlargement of five operating incinerators to provide from 1,000 to 1,500 tons of additional capacity, and the modernization of four operating incinerators to increase their capacity and economy. The remaining two of the eleven incinerators in the city will be dismantled.

The city's total refuse collection amounts to about 11,000 tons daily. At present, 4,600 tons, or 42 percent, is burned in the eleven operating destructors which vary in age from 15 to 30 years. Available land-fill areas, which now absorb the remaining 6,400 tons, or 58 percent, are rapidly being exhausted. Completion of the current construction program and the rehabilitation and modernization program which is planned to follow immediately, will provide capacity in properly located incinerators or destructor plants to dispose of all burnable refuse. Land fills will then be operated solely for the disposal of ashes, non-burnable refuse and incinerator residue.

Construction of the five new plants, designs for which were started about two years ago, is expected to be completed in approximately five years, and the remodeling program will follow at once. The total estimated cost, including engineering and sites, is $38,000,000. This cost is divided into about 25 millions for new plants and 13 millions for the enlargement and modernization of operating plants. It does not include other projects in a rather large sanitation program.

The four-million-dollar Betts Avenue Destructor Plant, now nearing completion in Queens, is the first of the new structures to be built under the current program. This plant is representative of present progress in incinerator design. It includes a number of features which, although unusual for destructor plants, merely exemplify the application of current engineering principles and practices

to a problem which, in general, has failed to share in the technical progress that characterizes today's municipal and industrial activities.

A survey of available commercial destructor plant designs indicated that such designs, introduced in the early years of this century, had not kept pace with New York City's requirements. These conclusions were unchanged by the fact that qualified observers have noted a general improvement in such designs since 1930. There were, however, two notable exceptions—the Greenawalt incinerator at Englewood, N. J., and the Volund incinerator at Atlanta, Ga. (CIVIL ENGINEERING for April 1949, page 20), both of which successfully burn municipal refuse.

Aside from these types, the choice appeared to lie with hand-stoked stationary grates and batch-fed furnaces with their arduous manual labor and other difficulties, including ash disposal. The Department of Public Works therefore set out to develop its own design for a modern plant.

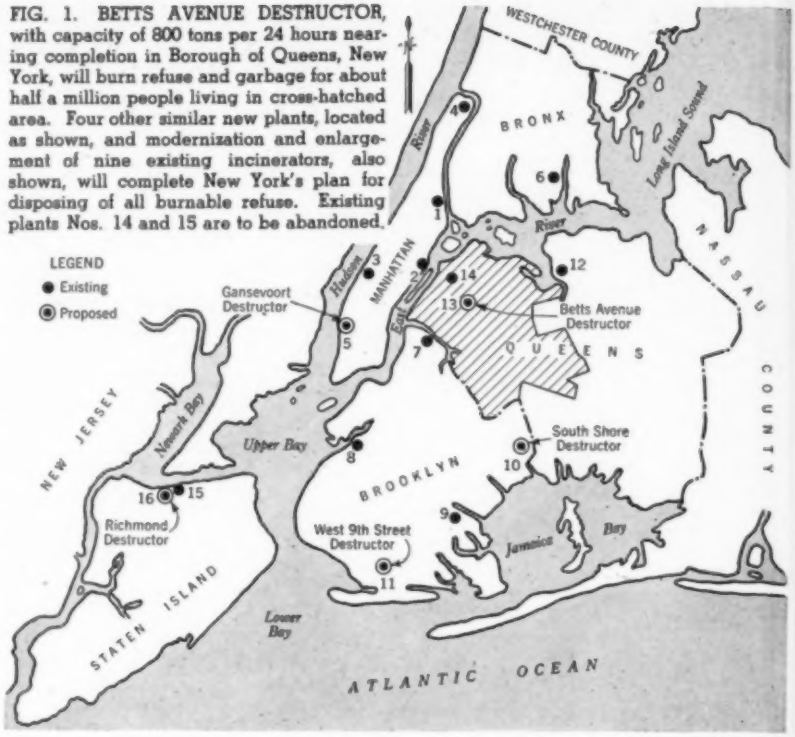


FIG. 1. BETTS AVENUE DESTRUCTOR, with capacity of 800 tons per 24 hours nearing completion in Borough of Queens, New York, will burn refuse and garbage for about half a million people living in cross-hatched area. Four other similar new plants, located as shown, and modernization and enlargement of nine existing incinerators, also shown, will complete New York's plan for disposing of all burnable refuse. Existing plants Nos. 14 and 15 are to be abandoned.

City Develops Its Own Design

With the intention of developing an up-to-date, labor-saving and economically efficient plant, a new design, of which the Betts Avenue destructor is the first example, was developed incorporating a number of unusual features. Among these are the shredding of material before feeding, furnaces equipped with traveling chain grates for automatic feeding, drying and stoking, and water-filled quenching pits for ashes and residue with scraper conveyors for loading trucks.

The new Betts Avenue destructor, under construction on the site of an obsolete and now demolished incinerator, is located in the Borough of Queens at Betts and 53rd Avenues. It will have a capacity of approximately 800 tons of refuse per 24 hours. At 2.7 lb per capita per day, it will serve 500,000 to 600,000 people, the population of the collection area shown in Fig. 1. This area is primarily residential, but includes a large, well-developed industrial section in Long Island City.

Deliveries to the plant will consist principally of domestic refuse collected by trucks of the Department of Sanitation, but will also include a relatively small amount of trade and other wastes. Under the current policy for the separation of refuse, ashes will not be received.

It is expected that the refuse delivered to the Betts Avenue plant will consist of mixed garbage and rubbish with varying amounts of moisture in the proportions, by weight, of 60 to 65 percent garbage and 30 to 40 percent rubbish, containing from 35 to 55 percent moisture. For design purposes, the burning value of this refuse as it reaches the burning hearth is taken as 4,000 Btu per lb.

Garbage in this mixture consists essentially of kitchen wastes, and the rubbish includes newspapers, paper cartons, wooden boxes and similar materials of which the moisture content varies with the weather at the time of collection. The rubbish contains some incombustible materials such as tin cans and glass bottles.

The weight of the mixed refuse varies considerably, depending on the ratio of garbage to rubbish, the moisture content and the degree of compaction. Samples taken from operating plants vary from 300 to 500 lb per cu yd. Designs for the Betts Avenue plant are based on an average weight of 400 lb per cu yd. Each collection truck reaching the plant will be weighed at the street-level entrance to the tipping floor (Fig. 2) on a 20-ton motor-truck scale provided with automatic weight-printing mechanisms (IBM system).

After their weight is recorded, trucks back up to the receiving pit for dumping. This pit, 20 ft wide, 20 ft deep and 164 ft 4 in. long, is an important element of the plant design. After several schemes of varying mechanical complexity had been developed for furnace feeding, a pit and crane type was adopted. The receiving pit has a level-full capacity of 2,400 cu yd, sufficient to provide storage capacity for 16 hours of continuous plant operation at nominal capacity without additional deliveries.

Space is available on the tipping floor for ten trucks to unload simultaneously if required. After dumping, the trucks proceed to the exit at the opposite end of the tipping floor, which extends the length of the building. The elapsed time between entering and leaving the plant is estimated at an average of five minutes per truck.

High-Speed Cranes Feed Furnaces

Two high-speed electric-drive traveling bridge cranes will handle the material from the receiving pit to the charging hoppers located 48 ft above the tipping floor level (Fig. 3). The cranes will operate at a hoist speed of 440 fpm, trolley travel of 300 fpm, and bridge travel of 250 fpm. The maximum lift will be about 75 ft and the maximum trolley travel, 40 ft. Each crane is equipped with a 3-cu yd clamshell bucket having special tines about 18 in. long. Buckets will handle 5 cu yd, or about one ton per cycle of operation.

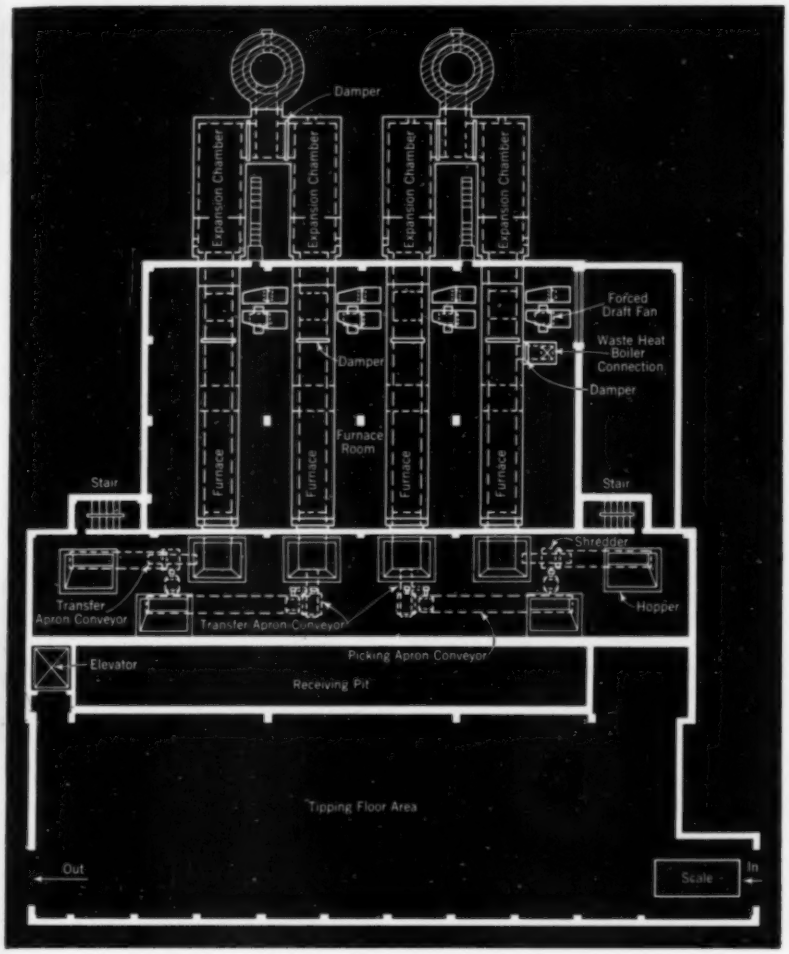


FIG. 2. In Betts Avenue destructor, wet refuse is lifted from pit by cranes and fed to four furnaces over moving drying stokers.

In addition to direct crane feed to furnace hoppers, an alternative method of feeding is available. Four motor-driven swing hammer mills, each having a nominal capacity of 30 tons per hour, can shred the refuse before it is discharged by conveyor belt into the furnace feed hoppers at a lower level. This arrangement involves separate hoppers on the charging floor and apron conveyors to and from the shredders. Provision is also made for a man to be stationed at the feed conveyor to each shredder to remove metals, other than tin cans and small objects, which might damage the shredders.

The shredding of refuse is regarded as experimental. The anticipated advantages in the more homogeneous material produced by shredding are believed likely to warrant the additional operating, maintenance and capital cost of this equipment. This first installation will provide operating data for use in future designs.

Although the shredders have more than sufficient capacity for this installation, their selection did not depend so much on large capacity as on the more ample dimensions of their feed openings. Under continuous operation, these large shredders are expected to be relatively free from jamming. The shredders are mounted on concrete foundations and coil-spring-type vibration dampers.

The four furnaces each have a capacity of not less than 200 tons per 24 hours. These furnaces will operate on a seven-day-week basis, with reduced operation on Sunday, when minor repairs can be made and fly ash removed from flues and expansion chambers.

The furnace volume is 9.0 cu ft per ton per 24 hours and that of the combustion chamber, 27.0 cu ft per ton per 24 hours based on a furnace rating of 200 tons. The heat release in furnace and combustion chamber combined is about 9,300 Btu per cu ft per hour when the furnace is operating at 200 tons per day. These figures are conservative and it is anticipated that the burning rate of the furnace will prove to be considerably more than its rated capacity. The furnace and combustion chambers are designed for a maximum temperature of 2,400 deg F, although temperatures exceeding 2,000 deg F are not anticipated. A bypass in the combustion chamber will divert up to 40 percent of the gases to the air preheater.

Mechanical Drying and Stoking Grates

Furnaces at this plant are designed with mechanical stokers. The results of tests at a pilot plant confirmed the opinion of our engineers that laborious and inefficient hand-stoking has no place in modern designs. Two traveling grates are provided in each of these furnaces, an inclined grate which serves for feeding and drying the refuse from the charging hoppers, and a large horizontal grate which burns the refuse and conveys the residue to the rear of the furnace, where it drops into the ash hopper.

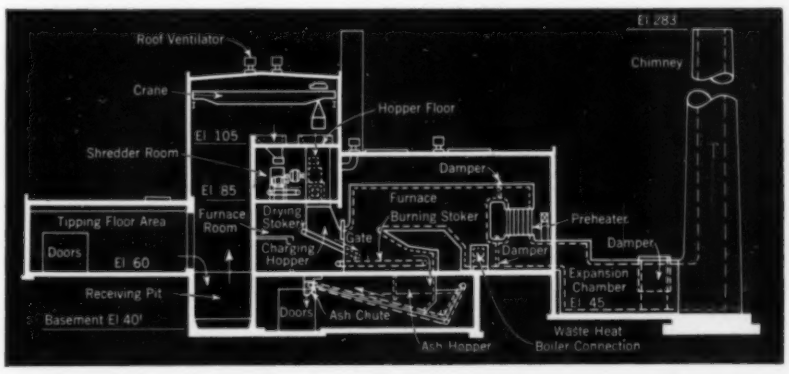
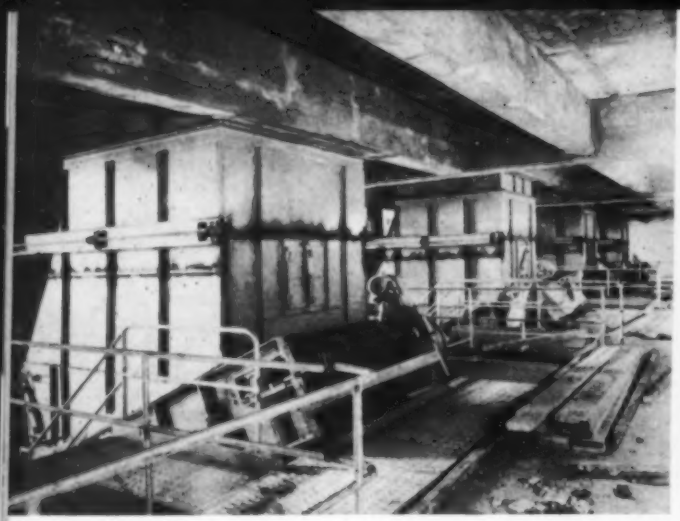
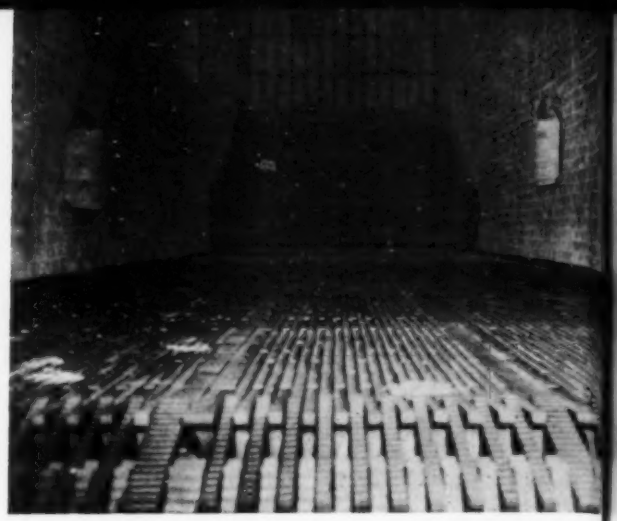


FIG. 3. FOUR MOTOR-DRIVEN hammer mills were installed to determine advantages of shredding refuse to uniform character before feeding it to furnaces.





REFUSE, either shredded or as is, falls through hopper shown in photo at left, onto inclined moving drying stoker which feeds traveling burning grate. Speed and depth of feed are adjustable. Interior of one burning furnace looking towards its drying stoker is seen in photo at right. Vertical gate in background is lifted to regulate depth of fuel bed on lower drying end of stoker.

The drying grate within the furnace is 8×8 ft—an effective drying area of 64 sq ft. The burning stoker is 8×22 ft—an effective burning area of 176 sq ft. Each stoker is equipped with variable-speed drive, providing for independent speed adjustment of from 10 to 150 ft per hr. The depth of the fuel bed on these grates is varied by adjustment of the gate at the base of the charging hopper. By varying the speed of the burning stokers at the rated furnace capacity of 200 tons per 24 hours, the feeding grate will handle 260 lb per sq ft per hr and the burning grate will reduce 95 lb per sq ft per hr.

The furnace charging hoppers have a capacity of about 35 cu yd, when full. This volume will provide for about 50 minutes of furnace operation without recharging.

The total effective area of both grates is 240 sq ft, which gives an average burning rate per square foot of burning area of 69.5 lb of refuse per hour. This rate is well within common practice in stationary-grate batch-fed furnaces in which large charging and ash gates are opened at regular intervals. The elimination of these openings in the Betts Avenue destructor will permit a much more exact control of the combustion air supply, both as to quantity and temperature, and thus secure greater combustion efficiency and a higher burning rate.

Two Oil Burners in Each Furnace

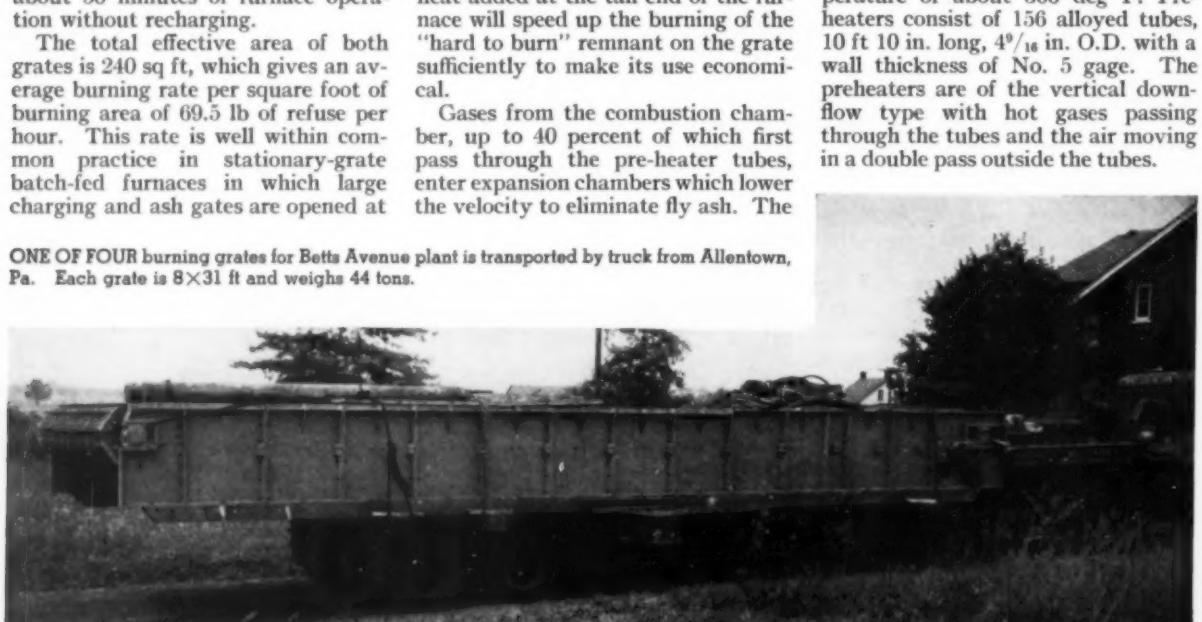
Two oil burners are being installed in each furnace. One is a circular-flame mechanical burner to be used to warm up the furnace when starting cold and to maintain furnace temperature when burning wet refuse or material of low heat content. The other is a flat-flame compressed-air-operated burner, an experimental installation to determine whether heat added at the tail end of the furnace will speed up the burning of the "hard to burn" remnant on the grate sufficiently to make its use economical.

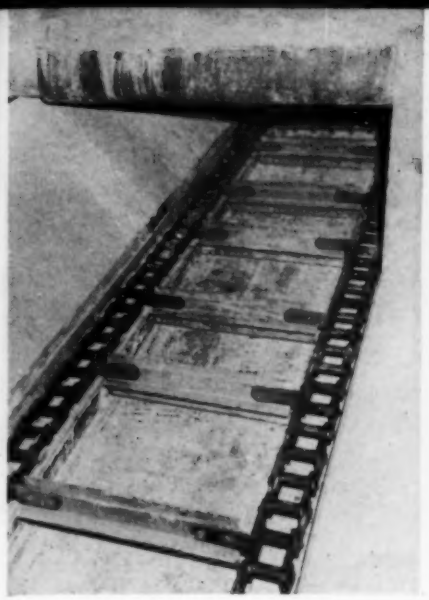
Gases from the combustion chamber, up to 40 percent of which first pass through the pre-heater tubes, enter expansion chambers which lower the velocity to eliminate fly ash. The gases then pass through two brick chimneys to the atmosphere.

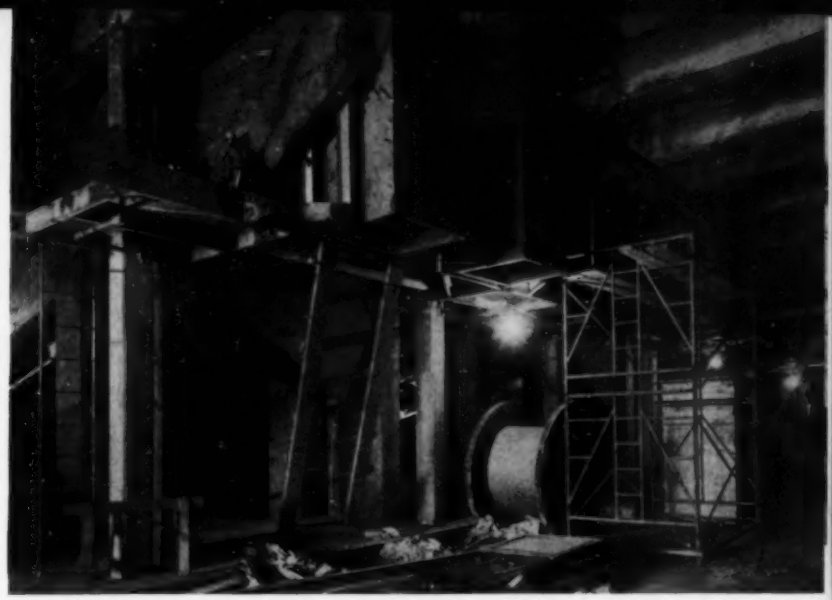
Each pair of furnaces is connected by dampered flues to a radial brick chimney of 10-ft inside diameter, and approximately 250 ft above grade. The chimneys are designed to carry off the gases with the furnaces operating at a 50 percent overload. At this maximum load and an estimated stack temperature of 900 deg F, the gas velocity in the stack will be approximately 40 fps. The chimneys are higher than necessary for draft requirements, the excess height being specified to guard against a smoke nuisance in the surrounding area.

Each furnace is equipped with an air preheater for heating primary combustion air to an operating temperature of about 300 deg F. Preheaters consist of 156 alloyed tubes, 10 ft 10 in. long, $4^{9}/_{16}$ in. O.D. with a wall thickness of No. 5 gage. The preheaters are of the vertical downflow type with hot gases passing through the tubes and the air moving in a double pass outside the tubes.

ONE OF FOUR burning grates for Betts Avenue plant is transported by truck from Allentown, Pa. Each grate is 8×31 ft and weighs 44 tons.







ASHES FROM end of each burning grate drop into two water-filled concrete troughs. Scraper conveyors transport ash residue to loading chute. Chutes in ash driveway, shown in foreground of view at right, discharge into trucks. Residue, about 100 tons per day, will be hauled to land-fill areas. Hopper seen behind wooden ladder encloses water spray system that clears scraper chains at beginning of return run.

The primary combustion air system of each furnace comprises a forced-draft fan and connecting ducts between the fan, the preheater and the air boxes under the stoker. Each burning stoker is divided into eight individually dampered air compartments spaced along its entire effective burning length, thus affording close control of the air supply throughout the length of the burning hearth.

Each furnace is also provided with a secondary air system consisting of a blower, connecting piping and nozzles. Air is drawn from the dead space behind the furnace arch and discharged to three air headers located behind the furnace arch. The purpose of the secondary air system is to provide good mixing of the gases and additional air to the surface of the fuel bed.

Ashes Quenched in Water-Filled Pit

Residue from the discharge end of the burning grates falls into the ash pit provided under each furnace. This pit consists of two inclined concrete troughs, each equipped with a scraper conveyor for transferring the residue from the pit to trucks for disposal. The pit is filled with water to quench the residue and is sealed to the furnace to prevent leakage of odors.

It is anticipated that the quantity of residue will vary from 10 to 15 percent by weight of the quantity of refuse burned. On the basis of the nominal capacity of the furnace, the residue should not exceed 30 tons per day per furnace. The capacity of the eight scraper conveyors is 60 tons per hour each, and the residue can be transferred to trucks in approximately five minutes of operation of each conveyor per eight-hour shift. Residue from the ash hoppers will be trucked to final disposal on land fill. An estimated 100 tons of residue per day will require approximately 20 truck loads.

The Betts Avenue destructor plant is housed in a steel, concrete and brick building of modern architectural design, to be attractively landscaped. The building is of structural steel frame with reinforced concrete floor, roof slabs and basement walls. Exterior walls are of brick and tile masonry. The steel skeleton type of construction was selected because of its simplicity and economy. The special spacing of interior columns was dictated by the arrangement of the four large furnaces. Fusion welding was specified for all built-up steel members and for most of the connections. The tipping floor was built as a reinforced flat slab directly on the fill. The foundations are designed as spread footings with an allowable soil pressure of 3 tons per sq ft.

Acceptance Tests Conducted in April

Demolition of the old plant was completed in January 1948. Construction of the new destructor was started on September 14, 1948, and the cornerstone was laid on September 1, 1949. Acceptance tests will be conducted in April 1950 by the Department of Public Works, assisted by operating personnel of the Department of Sanitation. When the construction of the plant and the acceptance tests are completed, operation will be under the direction of the Department of Sanitation. The plant will employ 60 men, about two-thirds the labor force for an old-style plant of similar capacity.

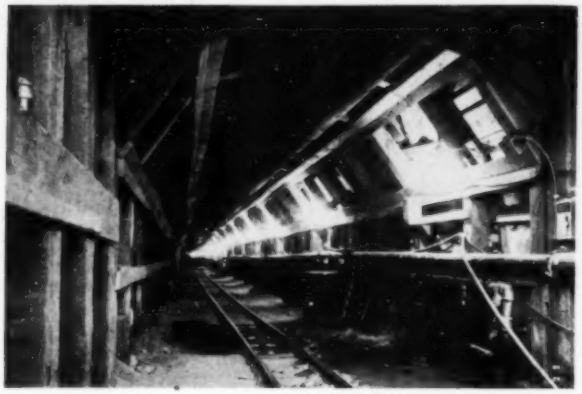
The principal contract for the structure and the equipment was awarded to Grove, Shepherd, Wilson & Kruge, Inc., for $3,540,000. Demolition of the old building, electrical work, heating and ventilating, plumbing, and portable equipment for the new plant, were awarded to separate contractors for a total of $520,745, making the total contract price of the Betts Avenue destructor, $4,060,745. At its rated capacity of 800 tons per 24 hours, the cost of the plant is about $5,000 per ton of capacity.

Design and Construction Organization

The planning and construction of the Betts Avenue Destructor are under my jurisdiction as Commissioner of Public Works. Plans were drawn and construction supervised by the Division of Sewage Disposal, headed by Richard H. Gould, Director, and Wellington Donaldson, Deputy Director, both Members of ASCE. Design was supervised by Henry Liebman, formerly Chief of the Bureau of Sewage Disposal Design and now Director of Operations, Department of Sanitation. William O'Leary, Assoc. M. ASCE, is now Chief of the Bureau of Sewage Disposal Design. In direct charge of design is Viggo Westergaard, Project Engineer. Heading design groups were George Iscol, Chief of the Mechanical Section, Victor Greiff, Chief of the Electrical Section, Louis Schwartz, Chief of the Structural Section, and Arthur Sigler, Architect.

Construction is under the direction of Alfred R. Glock, Chief, Bureau of Sewage Disposal Construction, and Nathan Miller, Resident Engineer. Designs were prepared in collaboration with the Department of Sanitation headed by William J. Powell until his retirement in December 1949. Andrew W. Mulrain is now Commissioner of Sanitation; and Joseph C. Zengerle, Senior Mechanical Engineer for that department, advised on the project.

AVERAGE PROGRESS OF 43½ ft per day is made at face of Tunnel No. 2 (left). General Electric storage-battery locomotive (marked "1") waits to remove muck car being filled by Conway type 50-A mucking machine with 42-ft conveyor belt. Tunnel here passes through volcanic rhyolite, requiring support with steel 5-in. WF 18.5-lb beams, delivered in two parts and wedged and bolted at arch. Before steel was available, wood was used (below). About 65 percent of this tunnel requires support.



Tunnel Records Broken at Owens River Gorge

W. C. MASON

Project Engineer, Department of Water and Power, City of Los Angeles, Calif.

BREAKING HARD-ROCK tunneling records is all in the day's work for crews driving the three main tunnels of the Owens River Gorge Power Project, to develop 112,500 kw of hydroelectric power for the City of Los Angeles. (See article, "Los Angeles Builds Three Hydro Plants in Owens River Gorge," by W. C. Mason, CIVIL ENGINEERING, December 1949.) The status of the tunneling work on March 15, 1950, was as follows:

	Tunnel No. 1 2 Headings	Tunnel No. 2 1 Heading	Tunnel No. 3 1 Heading
Date started	8/29/49	6/13/49	7/18/49
Feet driven to Mar. 15, 1950	15,102	9,971	9,193
Estimated holing out date	July '51	Apr. '50	June '50
Total length, ft	31,050	11,092	13,907
Diameter, lined	10 ft	10 ft	10 ft

Tunnel No. 1, at the northerly end of the project, leads to the penstock of Power House No. 1; Tunnel No. 2 extends virtually from the tailrace of this power house to the penstock of the next lower plant, Power House No. 2; and Tunnel No. 3 similarly connects with the penstock of Power House No. 3, the lowest of the series, from which all three plants will be operated.

Tunnel inspection reports are made out for each shift by the inspectors of the Los Angeles Department of Water and Power. These reports provide data for determining progress, payments to contractors, amounts of materials used, formation of ground and other needed information. For instance the report for the swing shift at the north portal of Tunnel No. 1 on October 27, 1949 (not a record), shows a total progress of 31 ft in 8 hours, in unsupported section, with the sequence given in Table I.

A typical schedule (not a record) in hard rhyolite at the south portal of Tunnel No. 3, for September 13, 1949, in unsupported section for the swing shift, is given in Table II.

The new record on Tunnel No. 1 at Owens Gorge may be seen from the following tabulation, comparing the best records in Tunnel No. 1, in rhyolite tuff, with those in Tunnel No. 3, in hard rhyolite:

Items	Tunnel No. 3	Tunnel No. 1
Total footage, 31 days*	2,204	2,442
Av. footage per day	71.10	78.77
Total excavation, cu yd	10,107	11,061
Best footage, 24 hr	85	104
Best footage, 8 hr	31	41
Total pounds powder used, 31 days	31,343	33,787
Total pounds powder per cu yd	3.101	3.055
No. rounds, 31 days	250	253
Av. length of rounds, ft	9.74	10.97
Av. no. holes per round	35	31
Av. advance per round, ft	8.82	9.65

* Tunnel No. 1 record, north portal, was made between 8:00 a.m., October 24 and 8:00 a.m., December 2, 1949; and Tunnel No. 3 record, south portal between 8:00 a.m. August 25 and 8:00 a.m., October 1, 1949.

In breaking the tunnel-driving records, the same crews were used as in

TABLE I. TYPICAL SCHEDULE FOR 8-HOUR SHIFT, TUNNEL NO. 1

	Round 1	Round 2	Round 3
Setting up and drilling	60 min	45 min	40 min
Loading and shooting	25 min	40 min	20 min
Ventilating	10 min	30 min	10 min
Mucking	70 min	70 min	60 min
No. of holes drilled	32	32	32
Depth of holes	11 ft	11 ft	11 ft
Feet advanced	11 ft	10 ft	10 ft

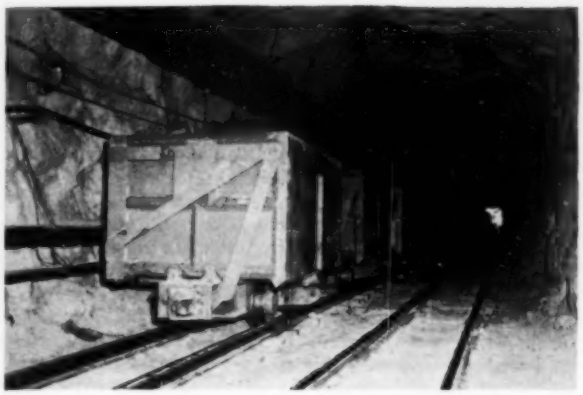
NOTE: Eighteen cars of muck were hauled out after each round. Because of the softness of the material, lightly consolidated rhyolite tuff, only 17 percent dynamite was used. No supports were installed on this shift and no water pumped.

TABLE II. TYPICAL SCHEDULE FOR 8-HOUR SHIFT, TUNNEL NO. 3

	Round 1	Round 2	Round 3	Round 4
Setting up and drilling		35 min	45 min	70 min‡
Loading and shooting		15 min	20 min	15 min
Ventilating		10 min	10 min	10 min
Mucking	15 min*	60 min	110 min†	65 min§
No. of holes drilled		34	36	36
Depth of holes		8 ft	10 ft	10 ft
Feet advanced		8 ft	10 ft	8 ft

* Finishing for previous shift.
† Lunch, 30 min.
‡ Laying long rails, 30 min.
§ Not finished at end of shift.

ADVANCE OF OVER 100 FT in 24 hours has been made in drilling Tunnel No. 1 (below) through lightly consolidated volcanic tuff. Here new world's record of 2,242-ft advance in 31 days, was made in fall of 1949. Sections slightly larger than normal are provided for double track at intervals of about one-half mile, for passing and for storage of muck cars, jumbo, mucking machine and locomotive. Novel car-passer (at right) is used close to heading for shunting single cars during mucking.



MUCK TRAIN BYPASSES empty car (above). Car passer consists of section of light-rail track about 14 ft long, of same 24-in. gage as main track, mounted on dolly. Two flat bars (shown at right of main track) are hinged to main track. When these bars are thrown over main track, dolly can be pulled on them into position over track and empty car pushed up on dolly. Car and dolly are then pushed off to left of main track and hinged bars are swung off to right, in positions shown, so that rest of muck train can pass. Card Iron Works tipple-type, side-dump muck cars are here seen in unsupported section of Tunnel No. 2 through hard rhyolite.

regular routine progress, and there was no special organizational setup for record-breaking purposes. No bonus money is paid for setting records but the general attitude of all crews is to "beat the other crews."

The previous record for bores of similar diameter was made on the Carlton Tunnel, Cripple Creek, Colo., in 1940, where the best progress was 1,879 ft for 31 days, 74 ft for a 24-hour day, and 27 ft for an 8-hour shift.

A typical crew for all shifts is: 1 walker, 1 shifter, 5 miners, 1 tool nipper, 5 chucktenders, 1 mucking-machine operator, 2 locomotive operators, 2 trainmen, 2 dump men, 1 compressor operator, 1 change-house attendant, 1 electrician and 1 mechanic. The day shift in the tunnel is augmented by 1 powder man and a bull gang consisting of a foreman and 4 to 7 laborers. The walker is the shift superintendent inside and outside the tunnel; the shifter is the shift boss or foreman in charge of operations at the heading and he operates the blasting switch.

The miners drill, load, set supports, crown bars, lagging, blocking, and collar braces, bar down loose rock and muck, set short track sections ahead of the mucking machine, and set long rails and piping as required. The tool nipper is the miner who cares for the drill steel, changes the rock bits, and is responsible for keeping a supply of drill steel, bits, wrenches, and hose on hand. Chucktenders change the lengths of steel in the drifter drills and assist the miners in raising, lowering and swinging the drifters on the column bars and arms of the drill jumbo and in routine duties. The bull gang lays track, air lines and water lines and hangs ventilating pipe. It also installs car passers and double track and keeps the track ballasted and to grade.

Drilling is done in three 8-hour shifts: day, 8:00 a.m. to 4:00 p.m.; swing, 4:00 p.m. to midnight and graveyard, midnight to 8:00 a.m. The bull gang works only on the day shift.

Of interest is the procedure used during mucking operations using a single track, one locomotive, and the car-passer shown in the photograph at the top of this page. In this photograph, the large 18-in.-dia steel pipe at upper right is for ventilating, carrying air from centrifugal blowers of 7,500 to 10,000-cfm capacity; the 6-in. pipe below carries compressed air for drills at 100-lb pressure from Sullivan and Ingersoll-Rand Compressors; and the 2-in. pipe immediatelv below is the water line. Lying on the compressed-air line is the 440-v three-phase cable supplying power for the mucking machine. The two wires on the left wall are the electrical firing line for blasting.

JUMBO STARTS DRILLING at south portal of Tunnel No. 2, where average progress is now 43 1/8 ft per day. Jumbo is 20 ft long, 24-in. gage, with four-wheel Timken-bearing double axle on each end. Front is rigged with four Ingersoll-Rand pneumatic motor-operated OJB boom-type arms equipped with I-R DA 35 pneumatic drifter drills. (Jumbos now at all headings carry five drills in front.) On rear of jumbo are two column bars and arms and bull hose which furnishes compressed air to drills. Boom arms swing in vertical arc of 30 deg and horizontal arc of 60 deg to give coverage of entire face. Operating valves and levers are so grouped that miner can operate boom arm and drifter drill from one position. Drills have working pressure of 100 psi and are of 3 1/2-in. bore, wet style, of standard rotation, with 1 1/8-in. diameter Leyner-lugged chuck. Power feed is suitable for 4-ft steel change. On this job, drill rods of hollow crucible steel in 4-, 8-, and 12-ft lengths, with Liddicoat "Throw-away" bits, have been used almost exclusively.

For the car-passing procedure, the following steps are used:

1. The locomotive pulls a string of 6 to 8 empty cars into the tunnel just past the car-passer.
2. The dolly of the car-passer is pulled into position by hand across the main track.
3. The last car in the train is uncoupled and pushed onto the dolly.
4. The dolly and car are pushed clear of the main track.
5. The locomotive backs the train toward the tunnel portal, past the car-passer.
6. The dolly and car are pulled back onto the main track, and the empty car is pushed off the dolly toward the heading.
7. The track is cleared of the empty dolly.
8. The locomotive proceeds toward the heading, pushing the empty car just bypassed and pulling the rest of the train.
9. Beyond the passer the train stops and the last car is uncoupled.
10. The uncoupled car is sided on the car passer while the train continues to the heading, where the empty car ahead of the engine is filled with muck.
11. The locomotive pulls the full car and pushes the rest of the train back past the passer.
12. The car on the passer is moved back on the main track, where it is pushed forward to the heading by the locomotive.
13. By a repetition of this procedure all the cars are soon filled and the train is pulled to the muck dump.

If a second locomotive is available, it goes at the rear of the train and stops with all except one car just before the train reaches the car-passer. The second locomotive then feeds empty cars to the passer while the head locomotive picks them up at the passer and pushes them to and from the mucking machine.

Car-passers are installed within 100 ft of the heading, and after tunneling excavation has advanced 250 to 300 ft, the car-passer is moved ahead so that it is again approximately 100 ft from the tunnel face. A repetition of this moving process therefore requires a locomotive to travel seldom more than 350 ft in shifting cars during the mucking operation.

All tunnels have double-track sections spaced at about half-mile intervals. These sections are about 200 ft long and are used to change the position of the jumbo and the mucking machine and for storage of dump cars and locomotives. During blasting, the jumbo and crews are withdrawn beyond the blasting switch, which is at least a quarter mile from the heading.

On this tunneling project the first round was shot at the south portal of Tunnel No. 2 on April 20, 1949, by force account. On May 19 a contract was awarded to the Owens Tunnel Contractors, who started operations on June 13. The joint venturers are Bressi and Bevanda of North Hollywood, Guy F. Atkinson Co. of Long Beach and San Francisco, A. Teichert & Son, Inc., of Sacramento, and David G. Gordon of Denver. Vincent Bressi is managing partner; George W. Foster is general superintendent.

For boring and lining 11.85 miles of pressure and penstock tunnels and constructing three surge chambers at the Gorge, the contractors' bid, on a unit price basis, was $8,947,520. The construction schedule calls for the delivery of power from Plants 2 and 3 in November 1950. Plant 1 power is due in the fall of 1951.

For the Department of Water and Power of the City of Los Angeles, the design and construction of the Owens Gorge project is directed by Samuel B. Morris, M. ASCE, Chief Engineer and General Manager, and C. P. Garman, Chief Electrical Engineer and Assistant General Manager. The writer is Project Engineer, in charge of inspection, field engineering, contractor contacts and force-account construction.

Connection to Power Plant Intake Made Under 20-Ft Head

Diver Works Six Days to Break Through Concrete Conduit Wall

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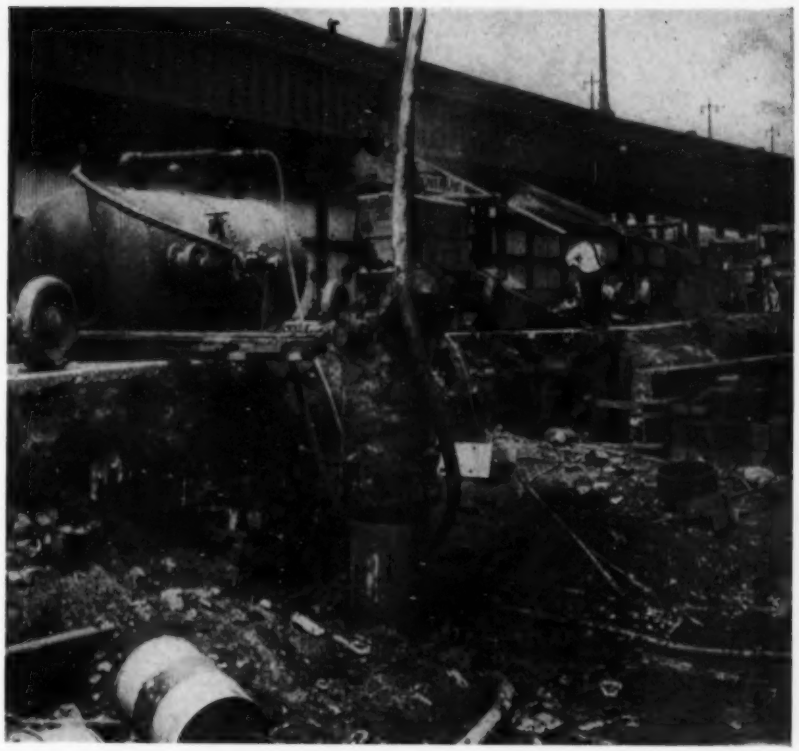
ENLARGEMENT of New York's 59th Street steam power station posed two main problems in subsurface construction. The most difficult problem involved the building of a branch condensing-water intake of 54-in. diameter under the ash tunnel and the coal conveyor to connect the new circulating chamber with the existing intake leading to the river. The difficulty was due to the fact that the water pressure in the river intake, which could not be shut off, would have to be equalized in some way in order to make the connection with the branch intake. This was done by flooding the circulating system and using a diver to breach the existing intake by means of a pneumatic concrete breaker.

The second problem, how to support heavy column and equipment loads, was solved by the use of Drilled-In Caissons and pipe piles driven to rock. Details of the work are here described. This power station, located on the east shore of the Hudson River, serves New York's Interborough Subway System.

Old Concrete Intake Found Adequate

A power plant requires large quantities of condenser water. The old power plant drew its water from the Hudson River through a concrete intake pipe 9 ft in diameter. Computations showed the capacity of this intake to be large enough to supply the expanded plant. The design for the expansion called for construction of a new circulating water chamber connected to the existing intake by a 54-in. concrete pipe. The pipe had to be carried beneath an existing ash tunnel which crossed the property, and an existing coal conveyor tunnel which adjoined the intake tunnel to the south, the invert being at El. −20, mean sea level. Excavation to the necessary depths and the installation of wood piles to support the intake between the ash and coal conveyor tunnels involved no special problems. Considerable quantities of water were



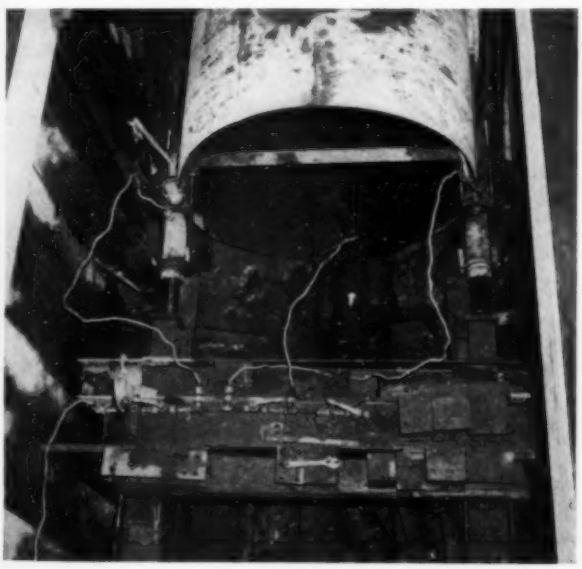
COMPRESSED AIR blows out 24-in. pipe pile after it has been driven to rock. Pipe will be filled with concrete. Two miles of pipe support extension of 59th Street power station for New York's Interborough Subway. To avoid even small settlements, all important loadings were carried to rock, about 65 ft below ground level at this location.

encountered despite the use of steel sheetpiling, but were easily handled by pumps.

Steel Pipe Jacked Under Ash Tunnel

After carefully studying the problem of tunneling beneath the ash tunnel and the coal conveyor tunnel, the contractor decided to attempt to jack a 78-in.-dia steel pipe under the ash tunnel. The space inside the pipe would then be ample for the installation of the 54-in. concrete pipe. If the procedure proved to be successful, the more difficult tunnel under the coal conveyor would be driven in a similar manner.

As the end of the open trench, in which the pipe was laid, was sheeted to prevent loss of ground under the ash tunnel, it was necessary to cut a circular hole through the sheeting to permit passage of the 78-in. pipe. The process involved two steps: (1) A circular cut was made in the sheeting large enough to accommodate the pipe, leaving short uncut gaps at the top and bottom, and on each side; (2) when the pipe was in place and under the pressure of the jacks, the circular piece was knocked out of the sheeting. This sequence of operations prevented significant ground loss under, and consequent damage to, the ash tunnel. The tunnel was underpinned and shored up in connection with the work. The jacks bore on a beam set across the excavation, engaging the steel sheeting on each side, and exerted an average thrust of 40 tons. Muck was removed by hand as jacking progressed. After the 78-in. pipe was in place, the 54-in. intake was set and grouted in position inside. Since the procedure was a success, the same method was used at the south end of the excavation to tunnel under the coal conveyor.

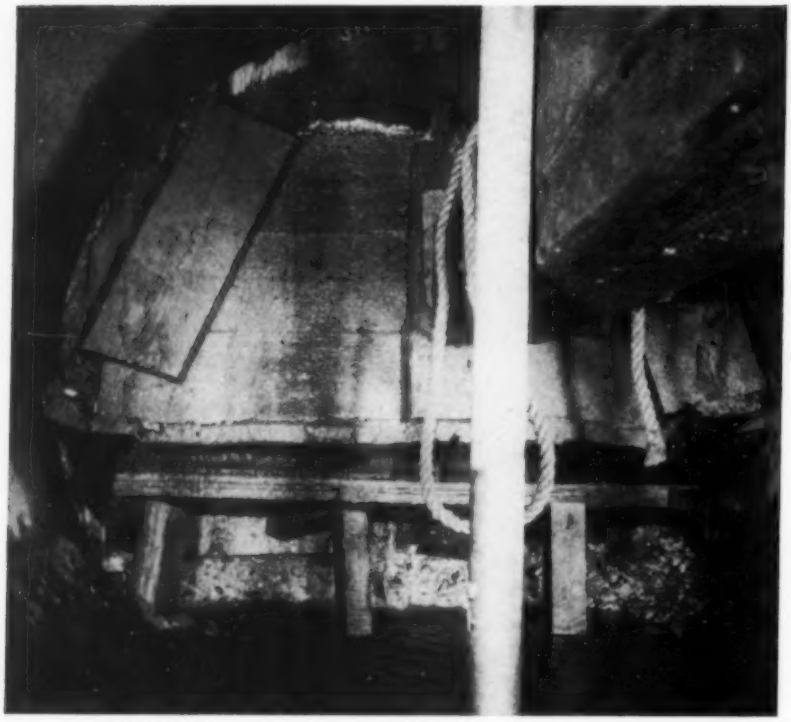


STEEL SHELL 78 in. in diameter is jacked under coal conveyor at south end of branch intake. Shell will be driven up to connection with existing river intake before 54-in. concrete pipe is placed inside. Muck is removed while jacking progresses.

The actual operations involved in tunneling under the coal conveyor however were much more difficult. The transverse steel sheeting at the south end of the excavation was cut through as before, and jacking proceeded without difficulty to a point about 18 in. north of the old intake. At this point a line of vertical wood sheeting was encountered, which had been installed in the course of the original construction. This sheeting was entirely below water level and in perfect condition. Exploratory holes showed that the lower part of the sheeting was in contact with the projecting concrete footing of the old intake. Above this concrete, there was a loose fill providing almost free access to the river.

To remove the concrete footing, a horizontal slit was cut in the wood sheeting about 2 ft above the invert of the pipe. Poling boards were then driven in at an angle, preventing the loose fill from washing into the pipe. After this protection was placed, the concrete footing was removed and the 78-in. shell was advanced until it was in complete contact with the old intake wall.

The next step was to cut a notch in the wall of the old intake around the perimeter of the large pipe so that it could be fitted into the wall of the intake and sealed, completely cutting off the water from the river. A penetration of nearly 12 in. served this purpose. The first cuts were



WOOD SHEETING from construction of existing river intake was encountered at south end of new branch intake and was in perfect condition. Exploratory borings showed footing of old intake extended above invert of steel jacking shell, and loose fill above that. Poling boards driven through horizontal slit in sheeting supported fill while concrete footing was chipped away beneath it, permitting advance of steel shell for new intake.

made in the face of the old intake while exploratory drill holes were made through the intake wall to determine its actual thickness. Thus it was possible to estimate the strength of the wall and the safe limit of tunneling before the final break-through. When this drilling had been accomplished, the 54-in. concrete pipe was set inside the 78-in. shell and the space between the two pipes grouted.

To prevent a rush of water while breaking through, it was important that the water pressure on both sides should be the same. Therefore the water was raised on the working side to El. 0, mean sea level (same as mean elevation of river). Before flooding the intake chamber and the pipe, an access manhole was constructed as close as possible to the existing intake tunnel. This manhole was formed by a piece of 30-in.-dia spiral-weld pipe similar to that used for the Drilled-In Caissons.

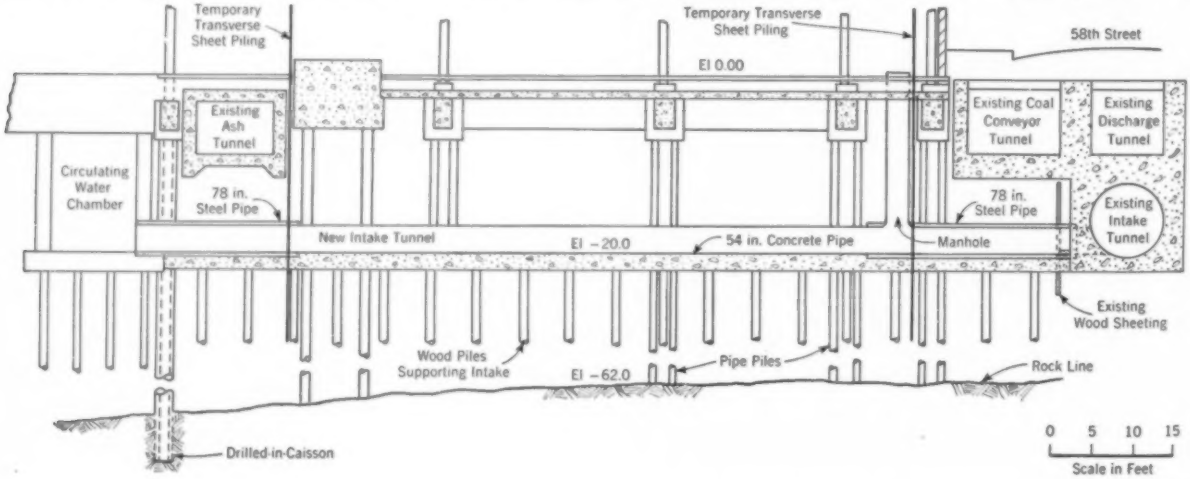
Entering through this manhole, a single diver worked inside the 54-in. pipe in a sitting position. He removed the concrete diaphragm in about six days using a mechanical concrete breaker. He passed the broken concrete back to the manhole, and loaded it into pails, which were lifted to the surface.

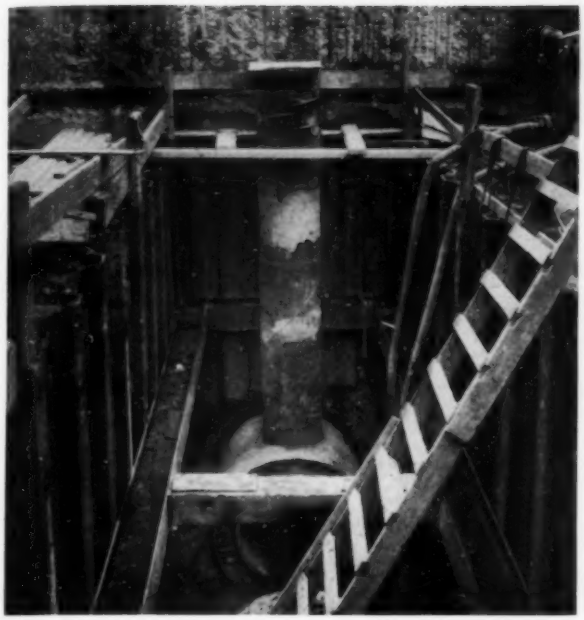
Pipe Piles Support Heavy Loads

At the east end of the old power plant building, solid rock is close to the surface, and the loads of walls and machines rest directly on ledge rock. The rock however falls off rapidly to the west until, at the junction of the new and old buildings, it is about 65 ft below the street. The overlying material consists mainly of river mud.

When the new addition was designed, it was appreciated that even small settlements were to be avoided in the foundations for heavy equipment. It was therefore decided to carry all important loadings to rock—not by pneumatic caissons but by means of pipe piles. The process involves driving steel shells 10 to 20 in. in diameter and $^{5}/_{16}$ in. or more in thickness, to rock, removing the material within the shells with explosions of compressed air, and filling the shells with concrete. Such piles proved to be the ideal solution to the

FIG. 1. **PROFILE** of new branch intake, looking east, shows existing tunnels under which steel pipe was jacked. Center section, between lines of transverse sheeting, was laid in open. Sheeting prevented loss of ground beneath existing structures and their consequent damage.





MANHOLE (left) permits diver to enter new branch intake, after flooding to equalize pressure, while making connection to original river intake which could not be shut off. Diver worked 6 days under 20 ft of water to break through into old structure.

TYPICAL Drilled-In Caisson carries heavy loads of plant addition. Steel shell was sunk to rock 65 ft below street and 14-in. WF 424-lb section with four angles was set in socket drilled into rock, then concreted.

problem of carrying to rock all but the heaviest loads of the new addition.

For 35 concentrations whose loads were as great as 1,554 tons, Drilled-In Caissons were used, whereby pipes 24 and 30 in. in diameter are sunk to rock by well drilling methods. A socket several feet deep is then drilled into the rock, a heavy steel structural member set into the socket, and the cylinder filled with concrete.

The owner is the City of New York, Board of Transportation; the engineers, Burns & Roe, Inc.; the general contractors, Thomas Crimmins Contracting Co.; the piling contractor, Spencer, White & Prentis, Inc.; and the Drilled-In Caisson contractor, Drilled-In Caisson Corp. The two miles of pipe used was supplied by Armco Steel Corp.

Can You Prove "Professional Exemption" Under Fair Labor Standards Act?

ROBLEY D. STEVENS
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MORE AND MORE engineering firms by court ruling are coming under the jurisdiction of the Fair Labor Standards Act because courts are expanding their already broad interpretation of what constitutes the production of goods in interstate commerce. Certain employees, it is true, are exempted from the wage and hour (minimum-wage and overtime-pay) provisions of the act. Of primary concern to engineers is the exemption allowed professional employees. Do your records substantiate your claims of exemption for employees? Can you protect yourself against costly back-pay claims? In the following article Robley D. Stevens (J. D.), a lawyer and former official representative of the U.S. Department of Labor, reviews the definition of "professional" and the records required to support claims of "professional exemption."

SINCE INCEPTION of the Fair Labor Standards Act of 1938, approximately 130 million dollars have been collected in back wages pursuant to official findings. This is a sizable sum of money for official agents to require in restitution from employers. The new FLSA of 1949, amended, which became effective January 25, 1950, increases the national minimum wage (Section 6) from 40 to 75 cents an hour. Section 7, which states that time-and-a-half must be paid for all work after 40 hours weekly remains the same, however. Some employees are specifically exempted either by meeting the requirements for being classified as an executive, administrative, professional or sales employee, or else as a result of collective bargaining by representatives of employees certified as bona fide by the National Labor Relations Board under the Taft-Hartley Act of 1947.

Employers should ask themselves these questions: Do my employment records substantiate my claims for exemption? Do I have all the required basic records? A complaint can be filed at any time requesting an inspection which may result in the digging up of old records by inspectors and in the quizzing of employees and ex-employees to uncover possible violations. Proof must be readily available in the form of records which, according to law, must be kept four years from the last date of entry.

Before discussing the basic record-keeping information essential, it will be helpful to explore the Regulations, Part 541, which define executive, administrative and professional exemptions. For purposes of brevity, this discussion will be confined to professional exemptions as defined in Table I.

It is essential for employees classi-

fied as exempted from the overtime provisions to meet *all* the basic requirements. Many employees of engineering firms which were supposedly exempted unfortunately did not meet one or another of the basic requirements. The employers consequently were directed by official demand to recompute back wages, which in some instances amounted to considerable sums.

Under the Fair Labor Standards Act, employers must keep complete records. While there is no particular form or order for keeping such records, certain accurate data can be listed as necessary. These include payroll records, union agreements, certificates in connection with wages, hours and working conditions. These records should be kept for protection and, of course, simplified records pay off.

There are many management guides for keeping complete, clear records. The items required by the Wage and Hour Division of the U.S. Department of Labor, which should be kept for inspection, are listed in Table II. Penalties may be imposed, and the Wage and Hour Division may bring criminal action against violators, which could result in fines as high as $10,000 and imprisonment.

A Decade Under FLSA

The Fair Labor Standards Act has been on the books for over a decade. Many engineering firms during this time have unwittingly misapplied the exemption clause or have kept inadequate records to substantiate claims and have been compelled to pay sizable amounts of back overtime, which might have been easily avoided.

That an engineer is a professional is not questioned, yet complete employment data should be kept for future reference to prove full compliance with the professional exemption clause. The Wage and Hour Division may receive a request from a complainant to make an investigation at any time, and the resulting inspection may prove costly if the firm cannot substantiate its claims. Engineering management cannot afford to take the FLSA for granted. Knowing what to look for, management can check claims by frequent contacts with the Wage and Hour Division for rulings. When violations are uncovered by the official inspector, it is almost too late for tales of woe. Can your wage-hour records prove compliance for last year, or today or tomorrow if they are audited by an inspector?

Appreciation is expressed for the suggestions of W. G. Stevens, Jr., Assoc. M. ASCE, in helping to prepare this presentation.

TABLE I. QUALIFICATIONS FOR PROFESSIONAL EXEMPTION

SECTION 541.3 of the regulations in the Fair Labor Standards Act of 1938, as amended to be effective January 25, 1950, defines the term "bona fide. . .professional" as follows:

> The term "employee employed in a bone fide. . .professional. . .capacity" in section 13 (a) (1) of the act shall mean any employee—
>
> (a) whose primary duty consists of the performance of work—
>
> (1) requiring knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study, as distinguished from a general academic education and from an apprenticeship, and from training in the performance of routine mental, manual, or physical processes, *or*
>
> (2) original and creative in character in a recognized field of artistic endeavor (as opposed to work which can be produced by a person endowed with general manual or intellectual ability and training), and the result of which depends primarily on the invention, imagination, or talent of the employee; *and*
>
> (b) whose work requires the consistent exercise of discretion and judgment in its performance; *and*
>
> (c) whose work is predominantly intellectual and varied in character (as opposed to routine mental, manual, mechanical, or physical work) and is of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time; *and*
>
> (d) who does not devote more than 20 percent of his hours worked in the workweek to activities which are not an essential part of and necessarily incident to the work described in paragraphs (a) through (c) of this section; *and*
>
> (e) who is compensated for his services on a salary or fee basis at a rate of not less than $75 per week (or $200 per month if employed in Puerto Rico or the Virgin Islands) exclusive of board, lodging, or other facilities: *Provided*, That this paragraph (e) shall not apply in the case of an employee who is the holder of a valid license or certificate permitting the practice of law or medicine or any of their branches and who is actually engaged in the practice thereof:
>
> *Provided*, That an employee who is compensated on a salary or fee basis at a rate of not less than $100 per week (exclusive of board, lodging, or other facilities), and whose primary duty consists of the performance of work *either* requiring knowledge of an advanced type in a field of science or learning, which includes work requiring the consistent exercise of discretion and judgment, *or* requiring invention, imagination, or talent in a recognized field of artistic endeavor, shall be deemed to meet all of the requirements of this section.

TABLE II. INFORMATION REQUIRED BY U.S. DEPARTMENT OF LABOR UNDER FAIR LABOR STANDARDS ACT*

Section 561.1

Employees covered by Section 6 (minimum wage rate) and Section 7 (overtime compensation). The following records should be kept:

- Name in full
- Home address
- Date of birth if under 19
- Occupation in which employed
- Time of day and name of the day on which the employee's workweek begins
- Regular hourly rate of pay, and basis on which wages are paid
- Hours worked each workday and total hours worked each workweek
- Total daily or weekly straight-time earnings or wages
- Total weekly overtime excess compensation
- Total additions to or deductions from wages paid each pay period
- Date of payment and the pay period covered by payment

Section 516.3

Employees under certain Union Agreements who are to be paid for overtime over 12 hours a day or 56 hours a week, as provided in Section 7(b) (1) or 7(b) (2). The following items should be kept for inspectional purposes:

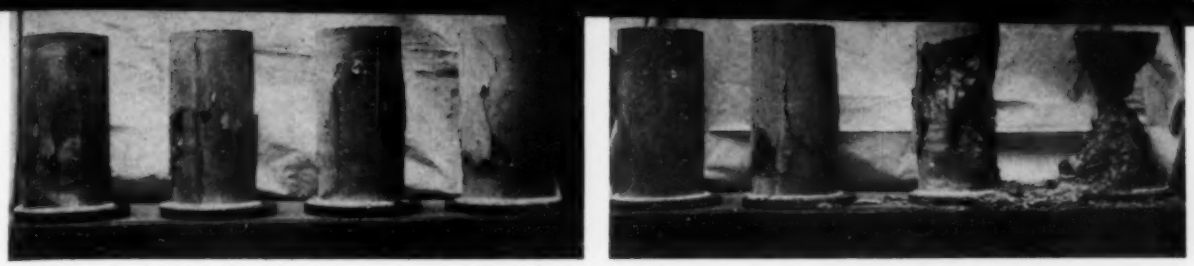
- Name in full
- Home address
- Date of birth if under 19
- Occupation in which employed
- Time of day and name of the day on which the employee's workweek begins
- Regular hourly rate of pay and basis on which wages are paid
- Hours worked each workday, and total hours worked each workweek
- Total daily or weekly straight-time earnings or wages
- Daily and weekly overtime excess compensation
- Total additions to or deductions from wages paid each pay period
- Total wages paid each pay period
- Date of payment and the pay period covered by payment

Section 516.7

Bona fide executive, administrative, professional, local retail, and outside sales employees as referred to in Section 13 (a) (1). The following items should be kept:

- Name in full
- Home address
- Date of birth if under 19
- Occupation in which employed
- Time of day and name of the day on which the employee's workweek begins
- Basis on which wages are paid
- Total wages paid each pay period
- Date of payment and pay period covered by payment

* Required pursuant to Section 11 (c).



TESTING MACHINE REDUCES all eight cylinders of high-strength (4,500-lb) concrete to fragmentary condition, with no trace of "elastic" or "plastic" range. Cylinder *E* (at left in right-hand view), which sustained load of 50,000 lb when test was discontinued, exhibited fine shelling cracks on all sides, clearly visible in original photograph. From left to right, cylinders and last loads carried are: *A*, 30,250 lb; *B*, 0 lb; *C*, 29,750 lb; *D*, 25,000 lb; *E*, 50,000 lb; *F*, 24,500 lb; *G*, 0 lb; *H*, 0 lb. All cylinders except *H* could be removed from machine intact. See Fig. 2 for plotted results of tests on these high-strength cylinders.

When Concrete Becomes Discrete

Cylinders Tested at Washington State Highway Department Laboratory Indicate No "Elastic" or "Plastic" Range

HOMER M. HADLEY, M. ASCE

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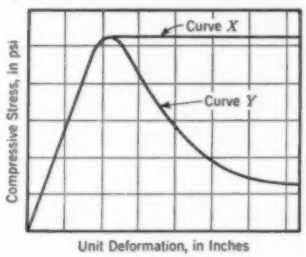
NEW THEORIES of concrete in flexure have been proposed during the past decade, based on the behavior of this material after its maximum strength in resistance to compression has been attained. Two types of stress-strain curves have been presented, *X* and *Y* in Fig. 1. Both curves, as applied to concrete, indicate a truly extraordinary metamorphosis.

Just what is concrete? A section cut through the material shows aggregate particles of all sizes and shapes, graded from large to fine, in an utterly random arrangement, all gripped tightly in a matrix of hardened cement paste.

Concrete is known to be strong in compression yet possessed of such limited strength in tension—about one-tenth of the compressive—that its tensile strength is rated as zero in design. Yet both curves *X* and *Y* indicate that 6 × 12-in. cylinders tested in compression up to maximum load will not shatter as it was long believed they would but on the contrary will remain intact and continue to sustain load. Curve *X* says there is continuous deformation under a sustained maximum load. Curve *Y* says there is continuous deformation under a decreasing load; once deformation has started, less and less load is required to produce the same deformation.

Under compression all materials tend to enlarge in a diametrically opposite direction, at a rate given by Poisson's ratio. Concrete is no exception. This enlargement of the diameter can only occur with an accompanying tangential tension. In reinforced concrete columns, hoops

FIG. 1. TWO TYPES of stress-strain curves, *X* and *Y* (below), represent theories proposed for behavior of concrete in compression. Curve *X* extends straight beyond point of maximum stress in so-called "elastic range." Curve *Y* descends and flattens as it extends into so-called "plastic range." Curve *Y* gives authentic record of prolonged cylinder test but fails to show point where fragmentation occurs. No resemblance to curve *X* was found in tests here described.



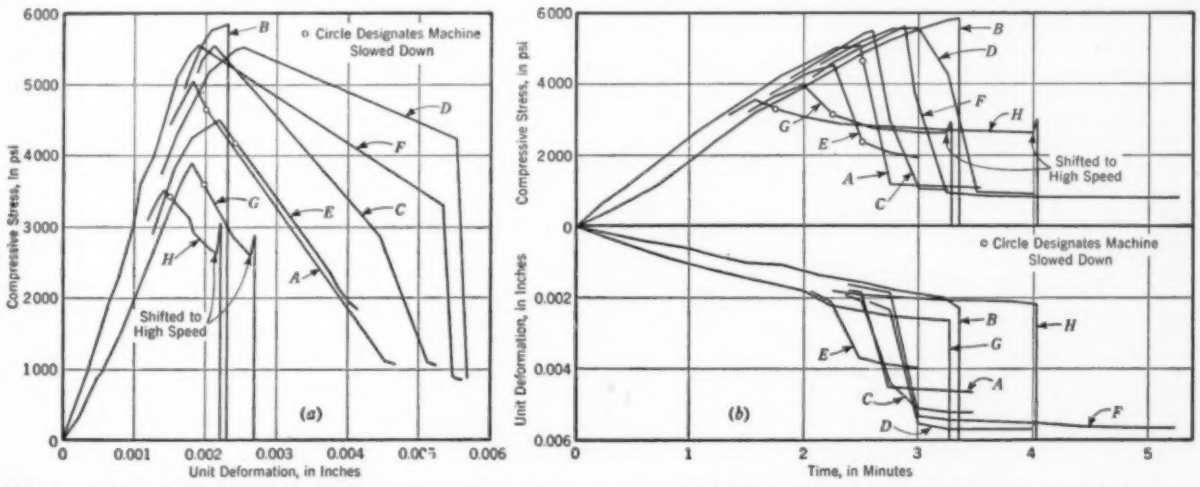
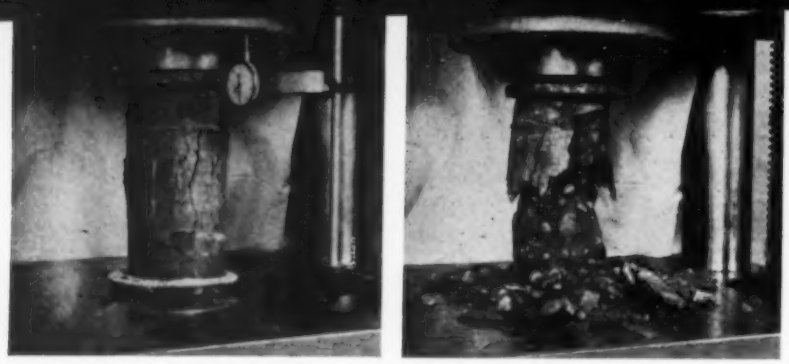


FIG. 2. EIGHT CYLINDERS of 4,500-lb concrete show marked similarity when tested in compression machine. (See also photographs at top of page.) Test results are plotted in usual manner in (*a*) at left. Because these curves, established by points marking successive 15-sec readings, give distorted view of time scale, same data are presented in (*b*) at right, in which unit stresses are plotted above horizontal time axis and unit strains below, so that simultaneous readings are on same vertical line.



CYLINDERS OF LOW-STRENGTH CONCRETE (1,500-lb) exhibit fragmentation under load in same manner as high-strength cylinders. Cylinder 2, at left, is carrying total load of 10,500 lb at end of its test. It is to be noted that its badly cracked condition is not revealed by curves in Fig. 3. Cylinder 4, at right, has failed at final load of 50,000 lb, or 1,770 psi.

or binders in the plain rodded type, or spirals in the spirally reinforced type, are used not only to prevent buckling of the vertical bar outward but also to overcome the tendency to split vertically on radial lines under axial loading. Therefore when curves X and Y indicate continued deformation under a sustained maximum compressive load or under a compressive load continuously decreasing from the maximum, with the concrete presumably maintaining its structural integrity and remaining concrete, it is obvious that either the concrete has undergone a remarkable alteration and has become curiously akin to a metal, or that curves X and Y are in error.

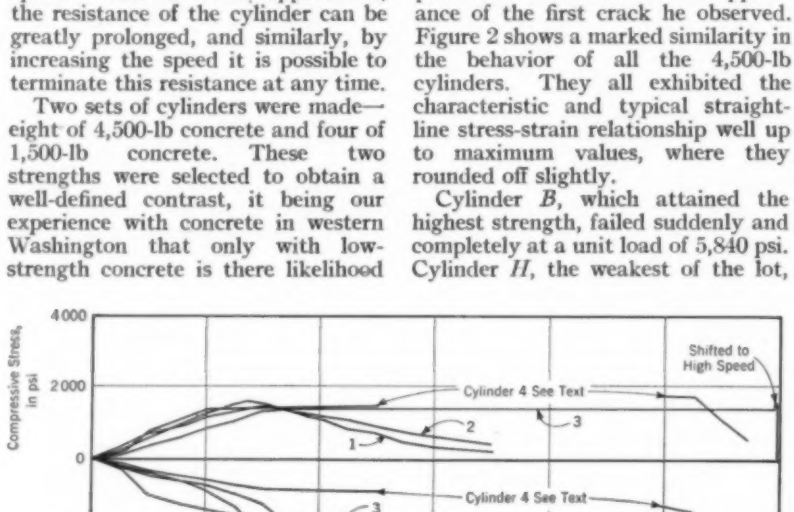
Cylinders Made and Tested

When the writer discussed this question a few years ago with Bailey Tremper, Testing Engineer of the Washington State Highway Department, it was arranged to test a dozen cylinders. The cylinders were made and cured at the Department's laboratory and tested at the age of 28 days with the object of determining exactly how they behaved after their maximum strength was attained. It has been contended that it is the sudden release of all the accumulated tension in the machine itself that brings about the shattering and rupture of test cylinders. Of course, in the world of full-size structures, failure-producing loads do follow through and apply undiminished in exactly this same way. However, with a modern testing machine, it is possible to control the speed of the moving head. By slowing the head speed as maximum load is approached, the resistance of the cylinder can be greatly prolonged, and similarly, by increasing the speed it is possible to terminate this resistance at any time.

Two sets of cylinders were made—eight of 4,500-lb concrete and four of 1,500-lb concrete. These two strengths were selected to obtain a well-defined contrast, it being our experience with concrete in western Washington that only with low-strength concrete is there likelihood of finding a plasticity at maximum strength resembling that of curves X or Y. In making the tests, readings were generally taken at 15-sec intervals, one man watching an electric clock graduated in seconds and calling out "28....29....*30*," or "43....44....*45*" as the case might be.

When the accented time was called, the man operating the machine called the load reading; the man watching the 0.001-in. dial indicator mounted beside the test cylinder, and bearing against the descending head of the machine, called out his reading; and a fourth man recorded. The man watching the dial indicator beside the cylinder also watched the cylinder closely as critical values were approached and called out the appearance of the first crack he observed. Figure 2 shows a marked similarity in the behavior of all the 4,500-lb cylinders. They all exhibited the characteristic and typical straight-line stress-strain relationship well up to maximum values, where they rounded off slightly.

Cylinder B, which attained the highest strength, failed suddenly and completely at a unit load of 5,840 psi. Cylinder H, the weakest of the lot,



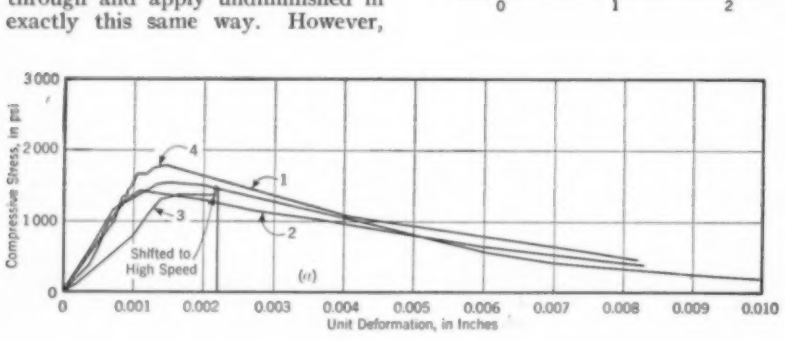


FIG. 3. FOUR CYLINDERS of 1,500-lb concrete were tested to failure. Curves in (*a*), left, are plotted in usual manner. To avoid distorted time scale, same data are presented in (*b*), above, with unit stresses plotted above horizontal time axis and unit strains below, so that simultaneous readings appear on same vertical line, to show time sequence, on same principle as Fig. 2 (*b*). With due allowance for their weaker character, these cylinders behaved similar to 4,500-lb cylinders plotted in Fig. 2.

attained a maximum strength at a unit load of 3,520 psi and then in the next few seconds started to fall off. The testing machine was thereupon thrown into slow speed 1 min 45 sec after starting the run, and at 4 min the apparent unit strength was 2,640 psi. No cracks could be observed at this juncture but the spurious nature of the cylinder's seeming integrity was revealed by throwing the machine into high speed. The needle momentarily shot up to a unit load of 3,120 psi, then dropped to zero.

Cylinder *G* resembled cylinder *H* but displayed a more pronounced loss in strength following its maximum value. All other cylinders showed a sharp and heavy loss in strength following maximum loads, accompanied by major increases in deformations. As the curves in Fig. 2 (*a*) show, a state of comparative stability then followed, the loads and deformations remaining practically constant until the tests were discontinued and the cylinders were removed from the machine. How utterly meaningless these residual strengths were, however, is clearly revealed in the accompanying photographs, which show the cracked condition of all eight cylinders on removal from the machine.

So far as this series is concerned, only one conclusion can be drawn: All cylinders failed at maximum load or closely thereafter. If the speed of the testing machine head was then slowed, the interlock of aggregate particles in the separate fragments held them together for a considerable time and enabled these fragments to sustain a rather surprising amount of load. If the head was put into high speed the fragments almost immediately shattered and fell apart and the needle plummeted to zero. In neither case was anything of practical structural or theoretical value to be observed. Once the maximum load was reached the cylinders failed. Up to the point of failure—at maximum load or at a slight recession therefrom—the material has structural value but once fission has commenced a wholly different situation obtains. The integral, coherent material is no more and only fragments remain. The concrete has become discrete.

The 1,500-lb cylinders were only four in number and naturally had a somewhat punky structure. However, with due allowance for their weaker character they behaved substantially the same as the 4,500-lb cylinders. See Fig. 3 (*a*) and (*b*), plotted in the same way as (*a*) and (*b*) of Fig. 2. Cylinders 1 and 2, having passed their maximums, lost strength steadily with accompanying pronounced deformations and final development of cracks. A photograph shows cylinder 2 carrying a total load of 10,500 lb—372 psi—at the end of its test. Observe that in Fig. 2 (*a*) and (*b*) there is nothing to reveal its sorry condition.

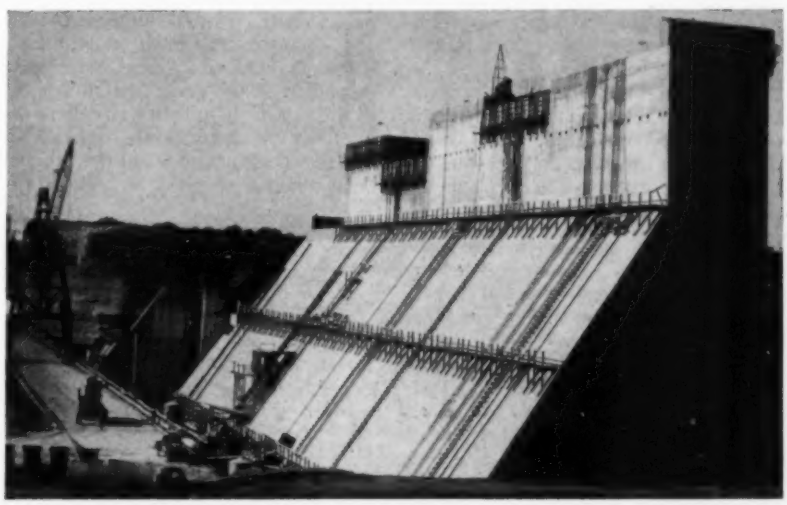
With cylinder 3 a different procedure was adopted. At 1 min 30 sec after the start of the test, a total load of 38,000 lb—1,345 psi—was attained. The machine was then stopped and, with only such increments of movement as were necessary, the load was held constant for 4 min 30 sec, during which period a slight steady increase of deformation occurred. At 6 min 0 sec, the machine was thrown into high speed; the needle shot up to 43,000 lb, then immediately fell to zero.

When cylinder 4 reached a total load of 37,500, 1 min 30 sec after starting, this value was held for about 5 min without any change of deformation. The load was then increased successively to 40,000, 42,000 and 44,000 lb, being held constant at each value for 5 or more minutes with little or no change of deformation occurring in any period. During the next period, under a total load of 46,000 lb, the cylinder began to yield, at the rate of about 0.0008 in. per min. When the load was stepped up to 50,000 lb, that is, 1,770 psi, it held for something over 15 sec and then let go, as shown in an accompanying photograph.

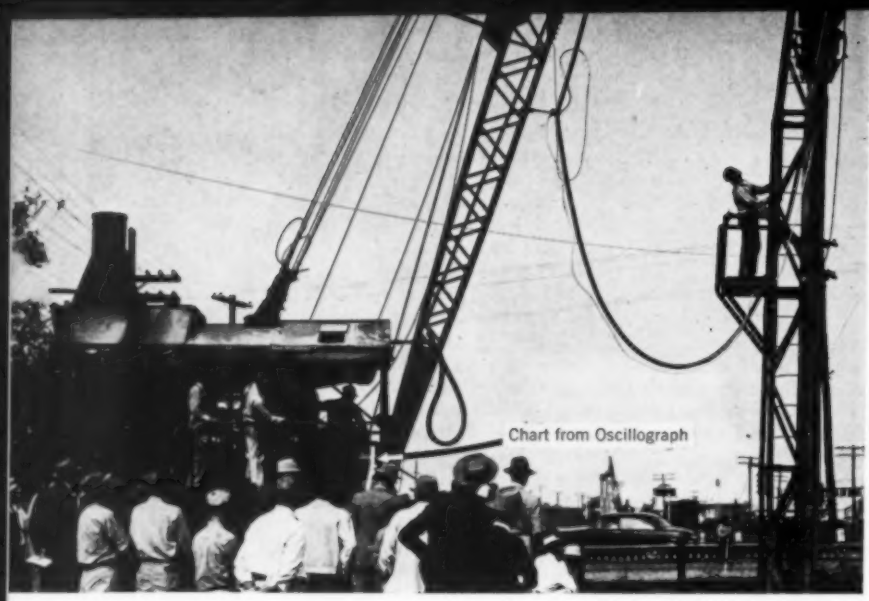
The only conclusion that can be reached from these tests is that ultimate "plasticity" of concrete is simply a state of cleavage and fragmentation arrived at after the concrete has ceased to be monolithic and has become an assembly of discrete particles held together by shear and aggregate interlock. It appears very probable that it is when the stress-strain curve first departs from a straight line that the first minute and scattered slippages and failures start to develop in the concrete. Then, as the load increases, these minute local failures become more numerous and at the ultimate load the increment of their weaknesses equals the increment of load. Shortly thereafter comes pronounced failure with higher-strength concretes, and cumulative crushing of the softer concretes.

Plasticity, as commonly thought of, does not occur. Fragmentation does. This is evident from the accompanying photographs. Curve *Y* of Fig. 1 gives an authentic record of a prolonged cylinder test but fails to distinguish between the two radically different materials involved—concrete and what may be called "discrete." Concrete terminates about the maximum point, becoming discrete thereafter. Nothing remotely resembling curve *X* of Fig. 1 was found in these tests.

Spillway Section of Whitney Dam Rises Above Brazos River, Texas



MASSIVE SPILLWAY 1,674 ft long, to rise 163 ft above streambed, was started in March 1949 and is now about half finished. It will be flanked by earth embankment 16,065 ft long. Entire job involves 1,774,000 cu yd of fill and 523,000 cu yd of concrete. Scheduled for completion in 1953, project is under construction by Galveston Corps of Engineers District, with Lt. Col. Ellsworth I. Davis, Assoc. M. ASCE, District Engineer.



PENETROMETER PERFORMS successfully in pile driving demonstration on canal job for Sewerage and Water Board of New Orleans, La. Chart from oscillograph is labeled. Follower is in leads, upper right, under hammer, and cable connecting it with oscillograph is loosely lashed to steam hose so as to be clearly visible. No. 2 Vulcan hammer of Bernard & Byrd, Inc., contractor, drives 60-ft-long creosoted yellow pine pile.

Penetrometer, New Electronic Device, Records Pile Penetration Under Hammer

A. BYRON HUNICKE
Industrial Engineer, Spring Hill, Ala.

NO ARGUMENT is needed to convince engineers of the value of pile penetration records. The problem is how to obtain such records simply and accurately. The old method of marking off 3, 6, or 12 in. on a pile and counting the hammer blows needed to sink it from one mark to the next is tedious and subject to many errors, as all results depend on the reporter's judgment and sustained accuracy in measuring, observing and recording. On a sizable job his patience is greatly taxed.

For such tedious methods the penetrometer substitutes an automatic electronically operated gage which measures and records the penetration of the pile under each blow of the hammer. The mechanism consists of the following parts:

1. The follower, a heavy steel shell containing an electric coil and a magnet, inserted between the pile and the hammer.

2. Two leads from the coil, contained in an all-weather cable, connecting with

3. The rectifier, which screens out the unwanted part of the motion, and passes on the wanted impulses to

4. The oscillograph, a standard, single-channel instrument, which can be placed wherever desired, preferably in the cab of the pile driver, where the operator can continuously consult the record to determine when the pile has been driven to design penetration.

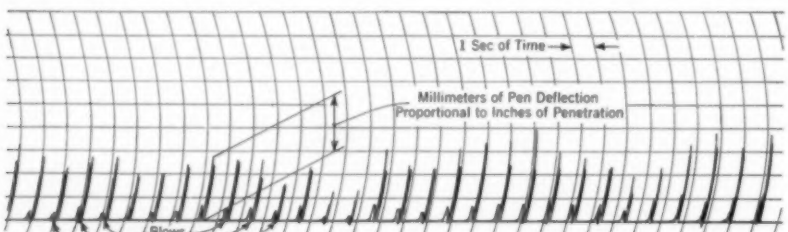


FIG. 1. OSCILLOGRAPH RECORDS 30 blows of hammer delivered in 32 seconds. Chart is cross ruled by curves of same radius as pen at intervals such that each curve represents time interval of 1 sec. Longitudinal rulings are at intervals of 1 millimeter with each fifth millimeter accentuated. (Only 5-mm lines are shown in reproduction, which is slightly less than actual size.) Pen is set to travel along one of horizontal lines as base line. Deflection for each blow on chart is not penetration of pile in millimeters but is proportional to it. Actual penetration in inches must be established for each hammer by calibration.

The oscillograph contains a pen and roll of chart paper. The current which activates the pen is generated in the follower but the chart drive requires 56 watts per hour from an outside source, such as

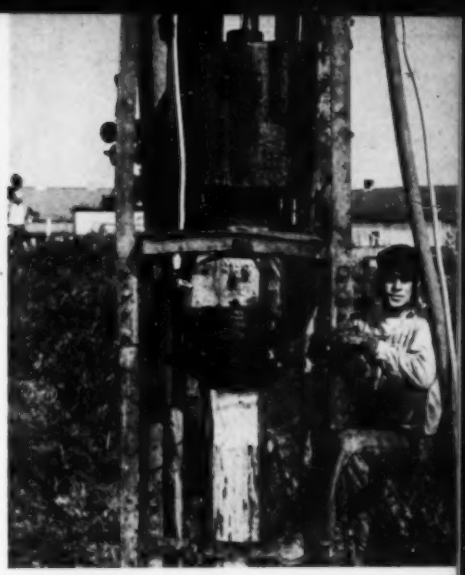
5. An ordinary electric light circuit at 120 v, or an inverter and 6-v automobile battery.

The unique part of the penetrometer is the follower, which was only produced after many studies and tests by the writer and his able associate, Lt. Col. B. W. Hutson of the Alabama Power Co. Within the follower is solidly embedded an electric coil standing vertically, its upper and lower halves wound in opposite directions. At each end the coil is sealed against movement in relation to its container, against dampness, steam, oil, dirt, air or gas, and against electromagnetic leakage. Inside the coil is in Alnico No. 5 magnet free to move vertically within certain limits.

In operation, hammer, follower and pile descend together. The coil goes with the follower, but the magnet, being free, remains behind for a minute fraction of time and then starts to fall by gravity, catching up with the follower after the force of the blow is spent. The variations in voltage differential induced by these relative movements have been found to be proportional to the distance moved. The oscillograph will faithfully record both the movement of the coil and that of the magnet, but since the movement of the coil includes any bouncing the pile may do, it is eliminated in the rectifier in favor of the movement of the magnet, which equals the net penetration gained. The oscillograph is accurate up to 120 cycles per sec, which is suitable for pile driving hammers delivering 150 blows per minute and less.

The oscillograph should be calibrated for a given hammer with the first pile driven. A master curve is thus obtained relating the pen deflections, in millimeters, to fractions of inches of penetration. Recalibration is required if a different hammer is used. If desired, the penetrations in inches can simply be written on their corresponding millimeter lines on the

INTEGRAL PARTS of penetrometer are: (1) Follower, built to fit at top into different sizes of hammer and leads, with piece bolted to bottom which can be changed to fit various sizes and shapes of piles; (2) rectifier which screens impulses from follower; (3) oscillograph which records with pen and chart relative depth of penetration of pile under each hammer blow; and (4) inverter, used between oscillograph and automobile battery where 120-v circuit is not available.



FOLLOWER, seen in position in guides between pile head and hammer, near right elbow of workman, has bottom part fitted over pile top and upper part hidden in hammer cup. Armored cable connecting follower with oscillograph extends up at left and down steam hose at right.

chart paper and read direct. See Fig. 1 for a typical chart record.

When the chart has been calibrated with the hammer, it is only necessary to specify the maximum penetration in inches desired. Then the operator can tell by a glance at the chart paper as it emerges from the oscillograph how the pile is progressing and when the specified penetration has been reached.

As soon as he knows the characteristics of the hammer to be used, the engineer can determine ahead of time what maximum penetration is permissible in fractions of an inch per blow. This can be converted to millimeters of pen deflection on the oscillograph, and the contractor need only tell his foreman that when the pen deflection consistently reads at or below the desired penetration, driving is to be stopped. Since the chart is visible at all times, the engineer or any member of his staff can see for himself at any time exactly how the driving is progressing. Copies of the charts, delivered to the engineer daily, will reveal whether or not the specification is being met. Also, if the specification cannot be met, this will appear clearly, thus giving the contractor and the engineer positive evidence on which to base any needed design changes.

Incidentally, blank spaces on the chart indicate idle time. The distance between the vertical rules represents one second of time. Lost time often can be studied to advantage to discover major causes for delays.

Another use for the oscillograph charts is for the construction of a log, made quickly by plotting the pen deflections for each stroke of the hammer in sequence and connecting their tips. Such a log will show up the differences in soil resistance at different levels and will indicate the safe bearing capacity of the pile by such a criterion as the Engineering News Formula.

A further step would be to convert each of the readings to its corresponding penetration in inches. Plotting these figures would reveal approximate depths of fault lines between zones of soil of different sustaining values. When motion of the pile between blows is accounted for, such figures can be made precise and related to surface elevations, pile tips and cutoffs, as well as to groundwater levels.

Human Relations More Important Than Mathematics, Young Engineers Are Told

From Address Before Washington, D.C., Student Chapter Conference

JOHN J. MANNING, M. ASCE

Vice Admiral, CEC, USN; Chief, U.S. Bureau of Yards and Docks (Retired); Vice-President, John McShain, Inc., Philadelphia, Pa.

YOUNG ENGINEERS have a disconcerting knowledge of many things that older engineers have forgotten. However, there are compensations for growing older in the engineering business. As the hard, bright facts of formal education begin to dull with time, we begin to develop a better understanding of human relationships and the ways and means of translating knowledge and ability into effective action. We learn that many phases of engineering have more to do with psychology than mathematics, and that quite often a slide rule can be of far less value than a sense of humor.

Among the qualities of a civil engineer which are less commonly recognized—but which must be acquired if his vital role is to be played out to the full—is the ability to present his case effectively to non-engineers. Frequently the engineer's attitude in this connection may be likened to that of the country man in the old English folktale who went to a village fair. He saw a large crowd gathered about an entertainer who was imitating the squeal of a little pig. The crowd was getting a lot of amusement out of the performance, but the country man thought the imitation a poor one. So the next day he returned and demanded that the crowd listen to his version of the squeal of a young pig. The crowd listened for a minute, then told him his imitation was no good. Whereupon, he reached inside his coat and pulled out the little pig which he had been pinching.

The crowd was still unimpressed, and still preferred the professional pig squealer. In other words, it is one thing to have a good product, and it is quite another thing to dramatize that product so that the layman will find it attractive.

Engineers experience a feeling of frustration when all too often they come off second best in their encounters with salesmen and politicians. The story has been told of a politician and an engineer, who after discussing some project of mutual interest, left the office of the engineer and went to his club for luncheon. As they entered the club they met a gentleman just leaving, The politician greeted him warmly and shook hands with him. As the politician rejoined the engineer, he said, "Don't you know Mr. So-and-So?" The engineer replied, "Yes, I know him." The politician said, "I didn't see you speak to him," to which the engineer answered, "He knows that I know him so why should I speak to him?"

Probably the young engineer will react to this characterization with a certain amount of defensive pride, interpreting the engineer's attitude as an indication of integrity. And probably he will be entirely right. Nevertheless, we should not accept with equanimity the fact that engineers lack the ability to persuade non-engineers to their point of view. Now, I know that the American people consider it an inalienable right to denounce politicians. Yet it must be admitted that the politician is highly skilled in dealing with intangibles. With amazing accuracy he is able to appraise emotions and prejudices and to harness those great human forces which no mathematical formula can measure or evaluate. Far from being contemptuous of such powers, we as engineers should seek to develop them for ourselves.

Avoid Professional Snobbery

Now, the question is how this can be done. I can't give all the answers, but I can make a few suggestions. The first of these is basic to the others. It is to avoid professional snobbery.

One form of such snobbery is the use of technical and scientific terms which are incomprehensible to the layman. To the young engineer who has just finished a course of intensive training which has taught him to think in technical terms, it may seem that the non-engineering mind is filled with cobwebs. Nevertheless, the engineer who possesses humility rather than arrogance in dealing with non-engineers is going to profit in the long run—and, for that matter, in the short run too. The farther engineers get from their theoretical training, the more value they will attach to those human relationships which are based upon open-mindedness and mutual respect.

Security Versus Professional Growth

Another important point is the tendency of young engineers to seek economic security at almost any sacrifice. Not long ago, the Bureau made a survey of senior engineering students in college to determine what they considered the most important inducement in a job opening. The majority wanted job security. Almost as many were interested primarily in salary. And close to the bottom on the survey were those few who wanted only the opportunity to develop professionally. A young man's desire for security is easy to understand, but security should not be sought for its own sake. It should come as the result of ambition, enthusiasm and hard work.

Some seventy years ago Ralph Waldo Emerson told a student audience: "When you are willing to renounce your ideals and ambitions for premature comforts and security, then dies the man in you, then once more perish the buds of art and poetry and science as they have died already in a thousand men. Explore and explore. Be neither chided nor flattered out of your position of perpetual inquiry. . . .Why should you renounce your right to traverse the starlit deserts of truth. . .for premature comforts?"

Another suggestion concerns the importance of speaking and writing effectively. Last year, because of the importance I attach to these abilities, I authorized groups of my coworkers to attend weekly classes in public speaking. The result was surprising. Men whose personal courage had never been in doubt and whose coats were covered with campaign ribbons and battle stars, had the look of boot sailors under fire for the first time. And the instructor informed me that they certainly must be good engineers because, with a couple of exceptions, they were the world's worst public speakers.

Frankly, that doesn't make sense. Those few engineers who have taken the trouble to rid themselves of the phobia against public speaking have been outstandingly successful. An example is my predecessor as Chief of the Bureau of Yards and Docks, Admiral Ben Morreell, Hon. M. ASCE, now President of Jones and Laughlin Steel Corp., who is an extremely effective speaker. And this ability played no small part in his success.

What has been said about the ability to speak in public applies with even greater force to the ability to write persuasive English. Unless young engineers have changed more than I think they have, they still study English with a minimum of enthusiasm—regarding it largely as a form of gibberish which liberal arts students use to wangle a degree without doing any work.

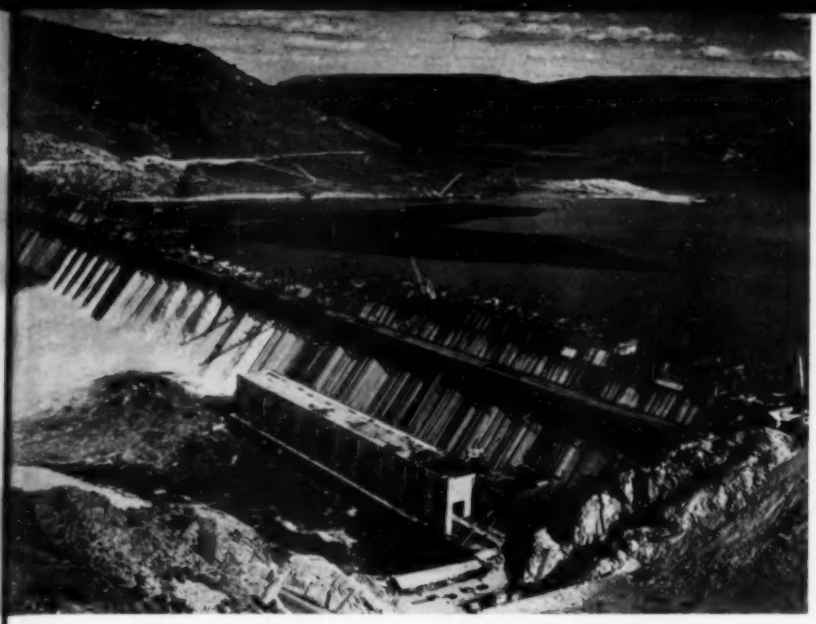
The ability to speak and to write effective English will aid the engineer not only to persuade his fellow engineers, but the people who hire engineers and who let contracts for construction and for engineering services. And ultimately, if the profession is to obtain the stature and the influence it deserves, the engineer must be able to plead its cause by persuasive writing directed to the public. The alternative is to accept the status of a hired technician.

Modern life is so closely integrated that the individual no longer can operate as an independent machine. He is part of the larger machine which is his community, and of the still larger one which is his country. In fact, we can hope that the day is not too distant when national barriers will be lowered to permit a true comity of nations.

Engineers' Activity Needed for Peace

In the meantime, our prime concern must be that the United States serve as the most powerful instrument for achieving order and peace. Unlike the groundless optimism indulged in after World War I, it is now realized that true peace is an elusive thing, which only continuing effort will attain. We have learned the hard way that Utopia is not "for free." Our country needs the engineers' active participation, his ideas, his enthusiasm, and his ability in the military Reserve Organizations. Passive support is not enough. The nation's influence for peace is only as strong as the force which lies behind it. We are citizens first and engineers second.

My advice to the young engineer is, in brief, to go beyond the narrow horizon of his technical training to the broader horizon of usefulness and influence in his community. If the young engineer recognizes that his fellow men can offer him as much as he can offer them, and that humility offers a faster road to success than pride and intolerance, he will reap rich satisfactions both as an engineer and as a citizen.



CONCENTRATED FLOW through 50-ft-wide diversion slots in Grand Coulee Dam during construction (see photograph at left) produced eddy currents below dam which carried river fill upstream into spillway bucket. Coarse material thus introduced, has eroded concrete at toe, requiring present repairs. FIG. 1 (below) shows profile of bucket with steel frame in place carrying side forms for concreting 5-ft-wide seats for floating caisson seen at bottom of page.

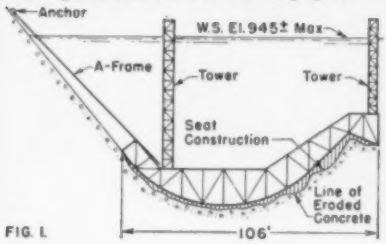


FIG. 1.

Floating Caisson Facilitates

Repair of Grand Coulee Spillway Bucket

L. V. DOWNS, Assoc. M. ASCE

Construction Engineer, U.S. Bureau of Reclamation, Coulee Dam, Wash.

TRADITIONALLY all overflow dams have sore toes, and Grand Coulee Dam on the Columbia River in the State of Washington is no exception to the rule. The Bureau of Reclamation is currently engaged in a program of preventive maintenance and under-water repair of damage to eroded concrete in the spillway bucket of that structure. Repair work is being done by the Pacific Bridge Co. with unique equipment and methods developed by Bureau engineers.

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Heavy River Boulders Erode Concrete Bucket

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The crowd was still unimpressed, and still preferred the professional pig squealer. In other words, it is one thing to have a good product, and it is quite another thing to dramatize that product so that the layman will find it attractive.

Engineers experience a feeling of frustration when all too often they come off second best in their encounters with salesmen and politicians. The story has been told of a politician and an engineer, who after discussing some project of mutual interest, left the office of the engineer and went to his club for luncheon. As they entered the club they met a gentleman just leaving. The politician greeted him warmly and shook hands with him. As the politician rejoined the engineer, he said, "Don't you know Mr. So-and-So?" The engineer replied, "Yes, I know him." The politician said, "I didn't see you speak to him," to which the engineer answered, "He knows that I know him so why should I speak to him?"

Probably the young engineer will react to this characterization with a certain amount of defensive pride, interpreting the engineer's attitude as an indication of integrity. And probably he will be entirely right. Nevertheless, we should not accept with equanimity the fact that engineers lack the ability to persuade non-engineers to their point of view. Now, I know that the American people consider it an inalienable right to denounce politicians. Yet it must be admitted that the politician is highly skilled in dealing with intangibles. With amazing accuracy he is able to appraise emotions and prejudices and to harness those great human forces which no mathematical formula can measure or evaluate. Far from being contemptuous of such powers, we as engineers should seek to develop them for ourselves.

Avoid Professional Snobbery

Now, the question is how this can be done. I can't give all the answers, but I can make a few suggestions. The first of these is basic to the others. It is to avoid professional snobbery.

One form of such snobbery is the use of technical and scientific terms which are incomprehensible to the layman. To the young engineer who has just finished a course of intensive training which has taught him to think in technical terms, it may seem that the non-engineering mind is filled with cobwebs. Nevertheless, the engineer who possesses humility rather than arrogance in dealing with non-engineers is going to profit in the long run—and, for that matter, in the short run too. The farther engineers get from their theoretical training, the more value they will attach to those human relationships which are based upon open-mindedness and mutual respect.

Security Versus Professional Growth

Another important point is the tendency of young engineers to seek economic security at almost any sacrifice. Not long ago, the Bureau made a survey of senior engineering students in college to determine what they considered the most important inducement in a job opening. The majority wanted job security. Almost as many were interested primarily in salary. And close to the bottom on the survey were those few who wanted only the opportunity to develop professionally. A young man's desire for security is easy to understand, but security should not be sought for its own sake. It should come as the result of ambition, enthusiasm and hard work.

Some seventy years ago Ralph Waldo Emerson told a student audience: "When you are willing to renounce your ideals and ambitions for premature comforts and security, then dies the man in you, then once more perish the buds of art and poetry and science as they have died already in a thousand men. Explore and explore. Be neither chided nor flattered out of your position of perpetual inquiry. . . .Why should you renounce your right to traverse the starlit deserts of truth. . .for premature comforts?"

Another suggestion concerns the importance of speaking and writing effectively. Last year, because of the importance I attach to these abilities, I authorized groups of my coworkers to attend weekly classes in public speaking. The result was surprising. Men whose personal courage had never been in doubt and whose coats were covered with campaign ribbons and battle stars, had the look of boot sailors under fire for the first time. And the instructor informed me that they certainly must be good engineers because, with a couple of exceptions, they were the world's worst public speakers.

Frankly, that doesn't make sense. Those few engineers who have taken the trouble to rid themselves of the phobia against public speaking have been outstandingly successful. An example is my predecessor as Chief of the Bureau of Yards and Docks, Admiral Ben Morreell, Hon. M. ASCE, now President of Jones and Laughlin Steel Corp., who is an extremely effective speaker. And this ability played no small part in his success.

What has been said about the ability to speak in public applies with even greater force to the ability to write persuasive English. Unless young engineers have changed more than I think they have, they still study English with a minimum of enthusiasm—regarding it largely as a form of gibberish which liberal arts students use to wangle a degree without doing any work.

The ability to speak and to write effective English will aid the engineer not only to persuade his fellow engineers, but the people who hire engineers and who let contracts for construction and for engineering services. And ultimately, if the profession is to obtain the stature and the influence it deserves, the engineer must be able to plead its cause by persuasive writing directed to the public. The alternative is to accept the status of a hired technician.

Modern life is so closely integrated that the individual no longer can operate as an independent machine. He is part of the larger machine which is his community, and of the still larger one which is his country. In fact, we can hope that the day is not too distant when national barriers will be lowered to permit a true comity of nations.

Engineers' Activity Needed for Peace

In the meantime, our prime concern must be that the United States serve as the most powerful instrument for achieving order and peace. Unlike the groundless optimism indulged in after World War I, it is now realized that true peace is an elusive thing, which only continuing effort will attain. We have learned the hard way that Utopia is not "for free." Our country needs the engineers' active participation, his ideas, his enthusiasm, and his ability in the military Reserve Organizations. Passive support is not enough. The nation's influence for peace is only as strong as the force which lies behind it. We are citizens first and engineers second.

My advice to the young engineer is, in brief, to go beyond the narrow horizon of his technical training to the broader horizon of usefulness and influence in his community. If the young engineer recognizes that his fellow men can offer him as much as he can offer them, and that humility offers a faster road to success than pride and intolerance, he will reap rich satisfactions both as an engineer and as a citizen.

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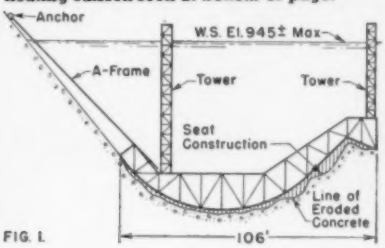

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STEEL FRAME for construction of caisson seats is assembled in circular concrete drydock, and 2-in. tongue-and-groove side-form sheathing is attached. When frame has been placed to line and grade in spillway bucket, divers adjust sheathing to fit eroded surface of bucket. Steel frame was actually principal form, its bottom skin plate forming contact surface of seat. In view on cover of this issue, barge transports steel frame suspended from it under water to position below dam.

dam over certain of the rows of blocks, which were left at lower elevations than adjacent ones, and through the outlet conduits. This diversion procedure resulted in concentrated flows over the spillway, which at times created eddy currents in the river channel below the dam severe enough to carry a considerable amount of river fill upstream into the spillway bucket. At the first inspection of the bucket by divers, it was found that river-bed material occupied a considerable portion of the spillway bucket and in places had a depth of 8 ft. This material consisted largely of heavy gravels and boulders, and occasional steel sheetpiling, remnants of construction cofferdams.

Dredging, First Remedial Step

Since the erosion in the spillway bucket was believed to be caused almost entirely by the abrasive action of these materials, their removal was the first remedial step adopted—by dredging, which was inaugurated in the fall of 1943. Study of this problem on an operating hydraulic model constructed to a scale of 1:60 determined that all materials above bedrock should be removed for a distance of about 300 ft downstream from the lip of the bucket and across the full width of the spillway. This conclusion was confirmed by the action of the great 1948 flood, when the downstream spillway roller created a false bucket in the river mantle, scouring out material for a distance of 300 ft downstream from the lip of the bucket.

Supplementing the dredging, preventive maintenance facilities for repairing the damage were provided, consisting of: (1) temporary needle valves to pass flood waters through the right powerhouse in order to extend the working season; (2) a circular concrete drydock 163 ft in diameter in which to construct, store and maintain special maintenance equipment; (3) a floating caisson within which the actual repairs in the bucket could be performed; (4) large winches for maneuvering the floating caisson during the trip to and from the dam; (5) a steel frame to be used as a form for the construction of seats on the eroded concrete of the bucket, upon which the floating caisson could be satisfactorily seated and sealed; and (6) a face caisson for use in repairing the areas higher up on the dam which would not fall within the working chamber of the floating caisson.

The floating caisson for repair of the spillway bucket, item (3) above, is a steel structure generally rectangular in plan, having outside dimensions of 58×114 ft, and a gross weight approximating 1,200 tons. The caisson consists of a series of compartments which are used for buoyancy; ballast and trim tanks to facilitate floating and submergence; and an open-bottom working chamber which fits the general shape of the bucket of the dam. Hoisting lines attached to a barge control the sinking and raising of the caisson. Hoisting equipment consists of four double drum hoists, which with the advantage of the 12 part lines at each of the four corners of the caisson, provide a total lifting force of over 1,000,000 lb.

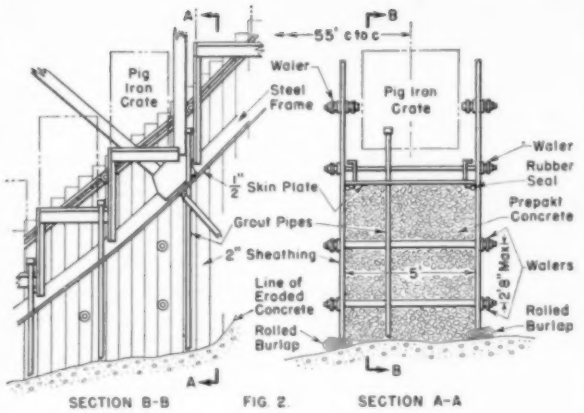
To facilitate sealing of the floating caisson when in position on an eroded section of the spillway bucket, and to increase the amount of work accomplished in a working season, a device was developed for the construction of concrete seats on the curved portions of the spillway bucket and on the apron. This device, item (5) above, known as a seat frame, is of structural steel, with plan dimensions of 106×62 ft (see Fig. 1). It consists of two principal side girders with bottom skin plates 5 ft wide, shaped to the theoretical sectional dimensions of the spillway bucket, and an end frame conforming to the theoretical shape of the apron downstream from the lip of the bucket. An A-frame was provided for attachment to anchorages on the face of the dam, and towers at the four corners extend from the side girders to a point above the normal water surface. The A-frame serves the function of precisely locating the seat frame in a lateral position in the bucket, and the towers are used to control the adjustment of the frame to exact vertical position.

The face caisson, item (6) above, rectangular and compartmented, is designed to provide an unwatered working space for repair of the spillway face below tailwater and above the area of operation of the floating caisson. This equipment has a gross weight of 250 tons, is 56×59 ft, with an over-all height of about 9 ft. It provides a working chamber free of obstruction for a height of 4 ft normal to the downstream spillway face. This face caisson also is equipped with a suitable A-frame and rigging for attachment to anchorages on the face of the dam, and with an arrangement of pumps and piping for controlling the ballast and trim tanks in the compartmented portion to permet raising and lowering while in use.

The remarkable regularity of this snow-and-glacier-fed stream permits an adequate working season in the spillway bucket and in the river channel below the dam without much danger of a sudden rise in the river. Furthermore with the installed hydroelectric generating units operating at or over rated capacity, the normal winter drawdown of the reservoir provides additional storage capacity for any early spring rises in river discharge.

On completion of the principal maintenance equipment, as previously listed, a contract was awarded in January 1949 to the Pacific Bridge Co. of San Francisco, Calif., to start repair of the spillway bucket and to dredge the river channel. The remainder of the 1948, and the present (August to March), season have been utilized in a vigorous program of repair, and the dredging has been completed.

The complete seat frame was first assembled on the right riverbank, utilizing an existing 40-ton cableway for handling the several parts. After required adjustments to secure exact compliance with the theoretical shape of the spillway bucket, the seat frame was cleaned and painted with aluminum paint and all panel points were identified for ease in underwater reference by the divers. Next the contractor removed the floating caisson from the drydock, closed the miter gates, and dewatered the work-



SECTION B-B FIG. 2. SECTION A-A

VIEW INSIDE FLOATING steel caisson after seating and dewatering (right) shows base of caisson at upper left resting on 4-ft-high Prepakt concrete seat. Dowel bars have been grouted into 30-in. holes drilled into eroded surface of spillway bucket, seen at lower right. Concrete caisson seats were cast under water in forms shown in Fig. 2 (left).

ing space. He then constructed temporary supports within the drydock and on them reassembled the completed seat frame.

To further expedite the work, the contractor assembled all the form sheathing along the sides of the seat frame in the drydock and provided all necessary attachments for the complete construction of the seats after the frame was positioned in the eroded part of the spillway bucket. At this point the drydock was flooded and the miter gates were opened to admit a large scow on which had been installed a pair of heavy lifting beams, tackle and winches for raising the seat frame from its position in the drydock and for carrying it under the floating barge to the spillway.

Divers Guide Frame to Position

When in proper position, the A-frame for the seat frame was anchored to the face of the dam, and divers were sent down to clean the surface of the eroded concrete beneath the seat-frame skin plates to remove debris, deposits of algae and other objectionable material. The divers then guided the frame to position in the bucket. Grade for the frame was established by differential levels from the fixed anchorage on the spillway face, shown in Fig. 1. The seat frame was supported on 2-in.-dia bolts extending through the skin plate and bearing directly on the eroded concrete. These supports, located in pairs at each panel point on the frame, were brought to uniform bearing at the precise elevation required.

Seats constructed with these forms are of Prepakt concrete. The Government is licensed, under contract with Lewis S. Wertz, to use the Prepakt process for this purpose. In this process a mixture of grout composed of sand, cement, water, finely divided pozzuolanic filler and a special agent, is forced under pressure into the coarse aggregate which fills the forms. Where the erosion was less than 2 ft in depth, the contractor was permitted to omit the coarse aggregate from the Prepakt construction. Since the forms were required to retain the grout mixture under pressure, it was important that they be tight and strong. The seat frame was designed for an unbalanced uplift pressure of 5 psi produced during the grouting operation, which was overcome by weighting the frame with ballast crates. A total ballast load on the completed frame of 375 tons of pig iron, crated in lots of 9,500 to 14,000 lb, net weight in water, was required.

After the seat frame was brought to final position, the wood form lagging was driven down by divers to firm contact with previously placed calking materials bearing on the eroded concrete. A satisfactory seal was secured by using long strips of burlap rolled to form ropes approximately 2 in. in diameter. Where gravel was required in the forms, it was passed through manholes and handholes provided at intervals along the skin plates of the frame. After the aggregate and necessary grout pipes were in place, the frame was loaded with ballast crates and the form was ready for grouting. The arrangement used in seat construction is shown in Fig. 2.

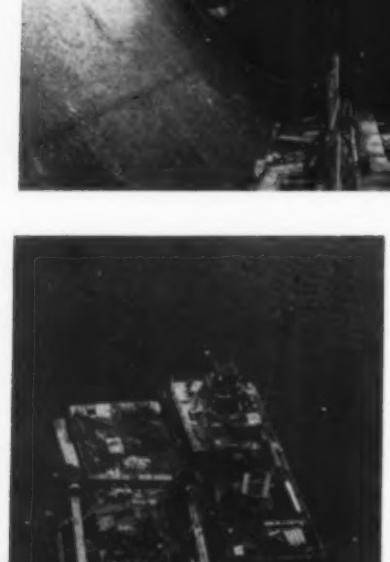
Grout materials were delivered to the site on a barge. Batching was by weight, and the grout was mixed in a 7-cu ft pug-type mixer discharging into a receiving tank from which the grout was pumped by a piston displacement pump through $1^1/_2$-in.-dia hose into the forms. Grouting was started at the invert of the bucket and progressed on each side of the seat intermittently. Grout was carried up both sides of the bucket, that is, upstream and downstream, and when the lip of the bucket was reached, grouting proceeded across the downstream end of the frame. Throughout the grouting operation the necessary connections to each succeeding grout pipe and observation of progress were made by divers. The progress of the grout was observed through suitable vents and by the return of grout from successive grout pipes. On each repetition of the seat construction operations, the contractor's methods improved and loss of grout was greatly diminished. The seats as constructed are eminently successful.

Composition of Grout Mixture

The grout mixture consisted of one part Type III cement to 1.2 parts sand, 0.2 parts fly ash, 0.012 parts special agent or grouting aid, and 0.62 parts water by weight. The grout had a thick, creamy consistency and was very satisfactory for pumping. After the grout had hardened sufficiently, the form lagging was removed. The bond between the seat and the skin plate was then broken by water pressure applied through connections in the frame which had been made for that purpose.

Seats were constructed in alternate blocks along the two sides and the downstream end of the caisson to provide contact for it on three sides. After each construction of a full set of seats, the seat frame was removed to the drydock, where the sheathing was replaced. The time required for construction of one complete set of seats varied from 21 to 31 days, depending on the volume of seat concrete.

Favored by an early low-water period in the river, the contractor started the repair program in August 1949. The first job was the removal



SPECIAL CAISSON (above) is attached to Grand Coulee spillway face to permit repair between tailwater level and bucket area covered by floating caisson. View at left shows floating caisson sunk to position on concrete seats on spillway bucket and dewatered. Equipment and materials are passed in and out through open shaft at far right corner. Scow alongside carries material, crawler crane and batching and mixing equipment.

of the floating caisson from the drydock. Until the river flow dropped below 80,000 cfs, the floating caisson was temporarily moored alongside the drydock while the assembly of the seat frame proceeded. When the river discharge became low enough, five $1^3/_4$-in. and 2-in. cables from shore-based hoists were attached, and the caisson was maneuvered to the dam. After completion of the first Prepakt concrete seats, and when the concrete had attained a strength of 3,500 psi, the caisson was moved into position and lowered.

As the caisson seals approached the seat, divers removed all foreign materials from the seat surfaces, and at the time of contact, additional sealing and supporting materials were inserted along the upstream side of the caisson where seat construction was not provided. When satisfactory bearing was obtained along the whole periphery of the caisson, it was lowered into final position and the barge was raised out of the water to provide additional load on the caisson seals to facilitate unwatering. Contact between the caisson and the prepared seat was made water tight by a pair of rubber seals each approximately 6 in. in vertical thickness by 12 in. in width. The caisson was completely dewatered and accessible to workmen at atmospheric pressure from three to five hours after the pumping started. The caisson was unusually dry considering the depth of the water, approximately 70 ft at the invert, and working conditions in it were extremely favorable.

Two of the shafts on the caisson contained pumps and piping for control of ballast and trim tanks, and for unwatering. These two shafts also contained the high-pressure pumps which accomplished the final dewatering and supplied water for construction. Access by workmen to the working chamber was through an electric elevator in the forward right shaft. Concrete and other construction materials and debris were passed in and out of the downstream left access shaft.

Repair of Eroded Concrete

Repair work in the caisson consisted of excavating the eroded concrete to a depth of not less than 18 in. in all areas where erosion exceeded 1 in., and replacing it with a minimum of 18 in. of new concrete, bringing the construction back to the original shape. Concrete was excavated by sinker and drifter drills, line drilling the areas to be excavated and breaking the concrete blocks out of the line-drilled recesses by "rock-jaks." In transition areas between concrete requiring no excavation and newly placed concrete, eroded surfaces were ground smooth with a 40-hp grinding machine.

After completion of excavation, holes for anchor bars were drilled and $^3/_4$-in. dowels were grouted in the concrete to a minimum depth of 30 in. Dowels were placed on 3-ft centers in rows 18 in. apart, and a mat of $^3/_4$-in. reinforcing steel on 18-in. centers was placed 5 in. below the surface of the finished concrete. Steel screeds extending in the direction of the spillway flow were placed in the concrete on 12-ft 6-in. centers to facilitate forming and to permit easy construction using the concrete mixes required.

Replacement concrete consisted of one part Hi-early strength cement (Type III), 0.84 parts sand, 1.56 parts of $^3/_4$-in. aggregate, 1.28 parts of $1^1/_2$-in. aggregate, and a water-cement ratio of 0.31. This concrete developed a 28-day strength of 9,100 psi when cured at a temperature of 45 deg F, which was the actual curing temperature in the spillway bucket where exposed to the river water. Materials were delivered on barges and the same mixer and batcher were used as for the Prepakt operation. Concrete was dropped through chutes installed in the open access shaft into a mixing hopper and distributed by buggies operating on a platform along the downstream apron of the bucket; thence the concrete was delivered in chutes to the point of placement. Work on a representative block consisted of excavating 222 cu yd of concrete and placing 261 cu yd, which with related work was accomplished in 31 days of actual working time.

INSIDE FLOATING CAISSON, concrete is placed by chute (top right) to build up eroded face of spillway bucket. Concrete of 1-in. slump, containing 9.2 sacks of cement per cu yd, is vibrated into place around reinforcing rods. Where new concrete joins old, and where erosion is less than 1 in. deep, motor-driven grinding machine removes surface irregularities (lower right).

Before the 1949 flood, repairs were made to eroded concrete on the right training wall of the spillway, and preventive maintenance was carried out in the form of a protective blanket of Prepakt concrete. This blanket, with a minimum depth of 3 ft, was placed over the right training wall footing on the tailrace side, as well as downstream from the wall. This work was performed to forestall erosion such as had occurred at a similar location on the left training wall as disclosed by soundings. The Prepakt concrete blanket contained washed aggregate $^{5}/_{8}$ to $1^{1}/_{2}$ in. in diameter, densified by the injection of grout of approximately the same mix previously described. Pipes extending above the water surface at intervals of 5 ft were used for grouting.

Dense Concrete Blanket Secured

No form was provided on the top surface of the blanket, and some difficulty was encountered in holding the mix to proper grade on the 3:1 slope specified. However, in general, a good, dense, consolidated concrete blanket was secured. Wood forms were used to confine the Prepakt concrete repair on the spillway side of the training wall, where erosion extended to an elevation above the normal apron of the spillway bucket at its line of contact with the training wall. Where forms were used, the Prepakt concrete provided an excellent means of repair.

The contractor carried out all phases of the repair work with vigor, using a well-balanced organization. The work schedule provided three shifts per day in a seven-day week whenever conditions warranted. The contractor's forces averaged 160 men during the regular working season and reached a peak of 213. Total earnings under the present contract will approximate $2,100,000. The contractor is to be commended for the safe practices employed; considering the character of the work, the safety record has been good.

Bids are soon to be called for a contract to complete the repairs now scheduled, which work can be completed in approximately two working seasons.

Divers Successfully Perform Difficult Work

Special mention should be made of the successful work performed by divers. Their inspection of conditions in the bucket under rather hazardous circumstances over a period of years is noteworthy, and the eminently satisfactory construction of the caisson seats and the repair of the right training wall by underwater Prepakt methods were remarkable performances. Their work as individuals and as a craft warrants special commendation.

Design and construction activities of the Bureau of Reclamation are supervised by L. N. McClellan, M. ASCE, Chief Engineer, Denver, Colo. Construction at the site is supervised by F. A. Banks, Assoc. M. ASCE, District Manager of the Columbia Basin Project, Coulee Dam, Wash. The contractor's operations are supervised by Charles Bisordi, Project Manager for the Pacific Bridge Co.

Cincinnati Plans Pollution Drive

County-Wide Sewage Disposal System to Protect Ohio River

H. H. KRANZ, M. ASCE
City Engineer, Cincinnati, Ohio

RAW SEWAGE from present Duck Creek Interceptor discharges into Ohio River at rate of 10 mgd. On Cincinnati bank alone, 60 outlets pour untreated sewage into already overburdened river. At Cincinnati, Ohio River drains 70,500 sq miles, receiving sewage from 8½ million people, with less than 30 percent treated.

CINCINNATI now has a long-range program under way for the collection and treatment of all domestic and industrial sewage from the city and adjacent districts, as part of the program to clean up the Ohio River. Long before the Ohio River Valley Water Sanitation Compact became a reality, Cincinnati was investigating possibilities for treating its sewage. By 1943 a plan had been submitted and accepted.

A technical subcommittee, appointed by the City Manager of Cincinnati to study and report on the plan, and on methods of financing, maintenance and operation, and to draft a form of contract agreement, recommended as follows: (1) that the city's proposed plan be adopted with any improvements or additions that the Ohio River Valley Water Sanitation Compact or a federal agency having authority in these matters may require, since the plan offers equal service to all communities without special favor or discrimination; (2) that a sewerage service charge be levied uniformly against all users of the sewerage system within the confines of the metropolitan sewerage area, as the best, most applicable and equitable method of financing the program of construction, maintenance, operation and amortization of the bonds; (3) that the construction program be developed over a period of 10 years instead of 7 years as originally contemplated; (4) that the form of contract or agreement and the sewerage service ordinance be accepted as satisfactory, subject to such revisions as may be required to fit the situation of the individual political subdivisions.

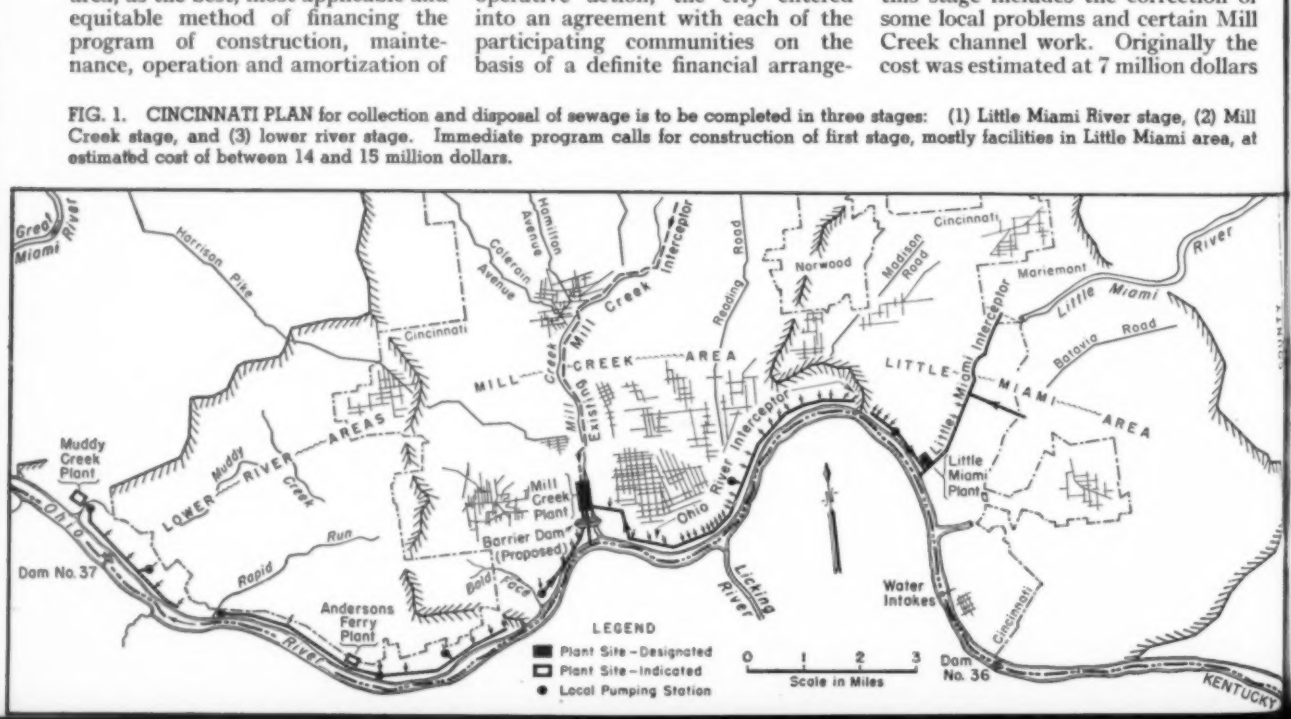
This report was presented to the conference of mayors and other officials of interested municipal bodies and was accepted. However, as with most non-military projects, Cincinnati's anti-pollution program was deferred until after the war.

In 1948, with the participation of Virginia in the Ohio River Water Sanitation Compact assured, the city again revived the issue. Since the sewage originating in the metropolitan area flows by gravity through the sewerage system of Cincinnati to several points of concentration as planned, it was logical to develop the program on a cooperative basis. It was likewise logical for Cincinnati to sponsor the program, since it will bear 85 percent of the cost.

Proceeding with the plans for cooperative action, the city entered into an agreement with each of the participating communities on the basis of a definite financial arrangement. To permit county cooperation, a state law was amended to permit the county to participate on the same basis as the other political agencies. Subsequently, on September 29, 1948, an agreement was executed by the County Commissioners. At present 21 of the 22 municipalities served by the city's sewerage system have executed an agreement with the city. The only exception, the village of Wyoming, Ohio, obtains its water supply from a source other than the City of Cincinnati and has decided to provide its own independent sewage treatment facilities.

Work on the Metropolitan Sewage Disposal Program, Fig. 1, is to be completed in three stages—the Little Miami River stage, the Mill Creek stage, and the lower river stage. The first stage, called the immediate program, calls for the construction of an extension of the Duck Creek Interceptor, the Delta Avenue pumping-station force main, the Mt. Washington branch sewer, the Little Miami Sewage Treatment Works, and the Mill Creek Outfall and Diversion Sewer, which will ultimately serve the Mill Creek Plant. In addition, this stage includes the correction of some local problems and certain Mill Creek channel work. Originally the cost was estimated at 7 million dollars

FIG. 1. **CINCINNATI PLAN** for collection and disposal of sewage is to be completed in three stages: (1) Little Miami River stage, (2) Mill Creek stage, and (3) lower river stage. Immediate program calls for construction of first stage, mostly facilities in Little Miami area, at estimated cost of between 14 and 15 million dollars.



SEWER OUTLET of Mill Creek Interceptor feeds 45 mgd of untreated sewage into Ohio River.

but at current prices it may be 14 to 15 millions.

The second stage includes construction of the Mill Creek Sewage Treatment Works and the east and west branches of the Ohio River Interceptor. This stage was originally estimated to cost $10 million but today will run to about 20 million.

The third stage, or lower river program, involves the construction of several small plants along the Ohio River, along with pumping stations and collector interceptors having a combined capacity of, say, 5 mgd. This part of the program would cost approximately $2,500,000 at current prices. Although it is difficult to predict costs accurately in these days of rising prices, the cost of the total program is estimated to range between 35 and 40 million dollars.

Using the information accumulated on a chart of the total annual cost, a curve was constructed. Then, assuming probable use, the incomes from various rates were plotted and it was determined that, although a $5^1/_2$-cent rate would leave a deficit, a 6-cent rate would give a slight margin of safety. These curves, shown in Fig. 2, indicate that it may be possible eventually to reduce rates if economic conditions remain stable.

Until the specific requirements for treatment in the "Cincinnati Pool" (that section of the Ohio River between Dams 36 and 37) were determined and officially mandated, Cincinnati's engineers could only mark time. To expedite matters, the Commission, at its meeting on January 5, 1949, took formal action and gave the Cincinnati Pool Hearing Committee an assignment to recommend standards for the treatment of organic wastes before discharge into the "Pool." Following the committee's report, on January 26, 1949, due notices were sent out and a hearing held on February 16. Finally, at the regular meeting in Pittsburgh on April 6, the Commission adopted "Treatment Standard No. 1," which establishes the standard for the treatment of sewage to be discharged or permitted to flow into the "Cincinnati Pool." These standards are:

1. Substantially complete removal of settleable solids

2. Removal of not less than 45 percent of the total suspended solids

3. Reduction by not less than 65 percent of the BOD of organic wastes, provided, however, that whenever conditions permit, a lesser degree of reduction of BOD, but not lower than 35 percent, may be applied to organic wastes, provided no impairment of a water-quality standard of 4.0 ppm of dissolved oxygen at the bottom of the oxygen sag in the Cincinnati Pool results.

Since then, the consulting engineers have restudied the situation for the Little Miami Sewage Works, and prepared a report on the "Basis of Design," which was submitted to the Director of the Ohio State Department of Health and was approved July 11, 1949. The consulting engineers then drafted specifications for the immediate contracts, which were submitted to and approved by the Chief Engineer of the Ohio State Department of Health on October 19.

General Contract No. 1 covers the fabricating, furnishing, supervising of erection and testing of the sludge filters and appurtenances. General Contract No. 2 covers the designing, fabricating, furnishing, erecting and testing of the sludge incinerators and appurtenances for the Little Miami Sewage Works. The present proposal is to purchase this equipment under separate contracts, permitting the city to exercise control over its selection so as to obtain the best available equipment and to secure detailed working drawings. Availability of such equipment drawings will enable the consulting engineers to complete the drawings for the buildings.

To protect both the contractor and the city from future fluctuations in labor and material costs, the contract contains an escalator feature covering, separately, increases or decreases in the composite price of "finished steel" and the hourly average wage of skilled labor. Labor and material indexes are keyed to schedules published periodically in certain reputable trade magazines, to determine the degree of fluctuation at a prescribed date during the life of the contracts.

The contracts also fix a limit for the adjustment in price at 10 percent above or below the price originally stipulated in the proposal. The lump-sum price of the proposal, as adjusted for fluctuations in labor or material costs, may be further modified because of state or federal taxes imposed or removed subsequent to the date of awarding the contract.

It seems appropriate to observe that every practical precaution has been taken in the endeavor to lay a sound foundation for the construction and operation of a sewage treatment and disposal system for the Cincinnati Metropolitan Area. Construction plans and financing and operation plans have been prepared with the assistance of recognized authorities in sanitary engineering and municipal finance. Sites have been purchased for the Little Miami and Mill Creek plants. In preparation for the Little Miami Plant, the main Little Miami interceptor sewer, the plant outfall and the Delta Avenue force main have been built. The first contracts for the plant proper will be let midsummer in 1950 and it is hoped that Cincinnati's first sewage disposal plant will be in operation not too long thereafter.

Needless to say, none of this could have been accomplished without the cooperation and support of the City Council and the two City Managers, C. O. Sherrill, M. ASCE, and W. R. Kellogg. The work, which is under the general direction of the City Engineer, is supervised by A. B. Backherms, Principal Assistant Engineer in charge of Sewers and Sewage Disposal, with the assistance of the consulting engineers, Havens & Emerson. Like all large engineering projects, it is a work in which many cooperate, and this cooperation is acknowledged with credit and thanks to all.

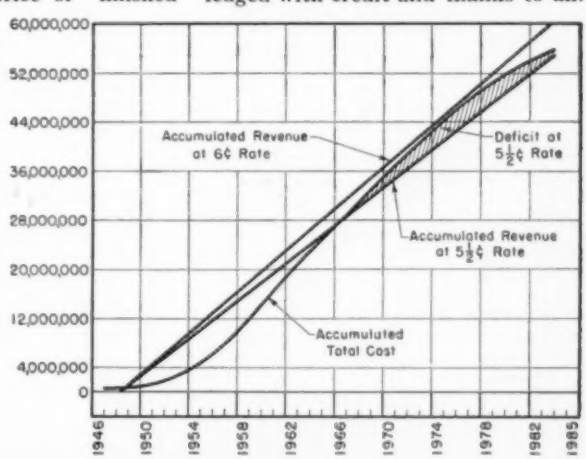
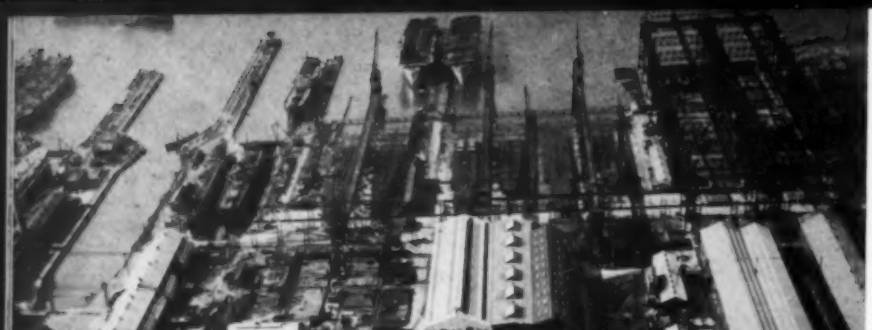


FIG. 2. ANALYSIS of base rates indicates advisability of 6-cent rate. Accumulated total cost is based on accumulated total annual costs including debt service, operation and maintenance, administration and collection.



SHIPWAY SECTION of Newport News Shipbuilding & Dry Dock Co. plant is seen as it appeared before modernization. White-roofed buildings in middle foreground are mold loft and fabricating shops, beyond which is runway for interchange cranes, running parallel to water's edge. Along waterfront are six shipbuilding ways. Two semisubmerged ways at right, with steel superstructure overhead, were built during World War I. To left of these, in approximate center of air view, are three elevated steel trestles carrying cantilever and whirler cranes serving four wooden shipways, two of which were removed to accommodate new shipways, as may be seen in photograph of completed project at top of facing page.

Modern Reinforced Concrete Shipway Built at Newport News

M. M. FITZ HUGH and J. W. IRVINE, M. ASCE

Respectively Plant Engineer and Assistant Plant Engineer, Newport News Shipbuilding & Dry Dock Co., Newport News, Va.

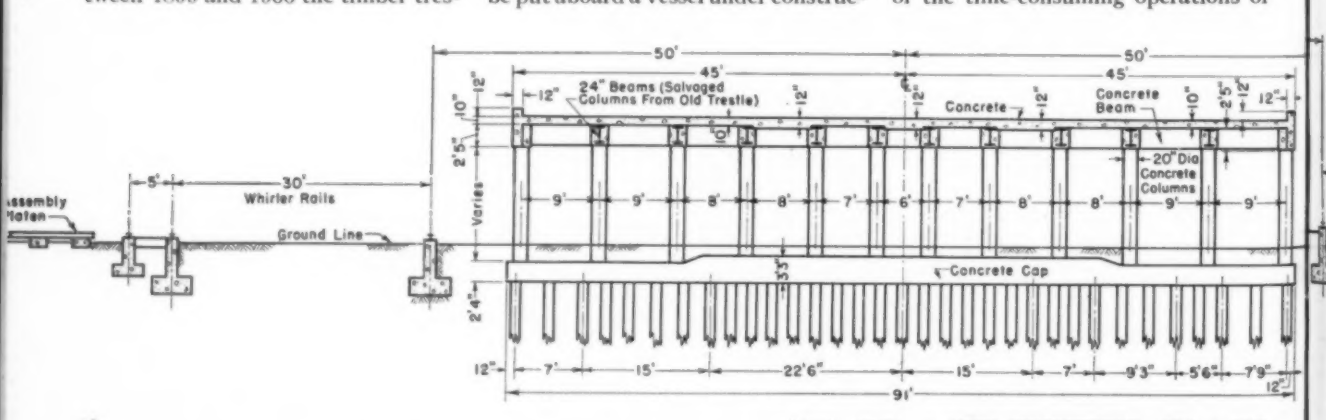
USE OF WELDING INSTEAD of riveting has revolutionized methods and plant at the Shipyard of the Newport News Shipbuilding and Dry Dock Co. New methods include the technique of fabricating large subassemblies on flat floors, or platens, alongside the shipways and later incorporating these subassemblies in the ship. An extensive modernization program, just completed, includes larger cranes and heavier tracks, heavier platens, and the construction of an 880-ft pile-supported reinforced concrete shipway to replace a former wooden shipway. Problems met with in the design and construction of this unusual concrete shipway, capable of handling vessels with a 675-ft length, a 90-ft beam, and a launching weight up to 15 thousand tons, are here discussed. Engineers will view with interest this departure from classic wooden construction.

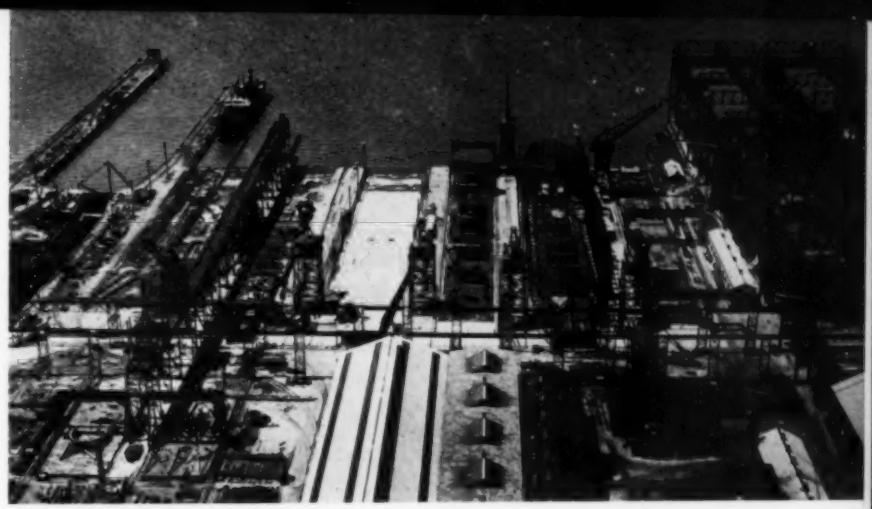
TIMBER CONSTRUCTION was used for all the shipways of the Newport News Shipbuilding & Drydock Co. from the beginning of its operations in the late 1880's until World War I. The original elevated trestles for carrying the cranes to serve the shipways also were of timber. Between 1899 and 1906 the timber trestles were replaced with steel. Of course, in the early days of the Newport News yard, all iron and steel ships were of riveted construction and no use was made of the subassembly technique as it is known today.

In those days the heaviest piece to be put aboard a vessel under construction was a shell or deck plate—which rarely weighed over four tons. All the heavier pieces of machinery, such as engines and condensers, were put aboard by the heavy cranes at the outfitting piers after launching. The earlier shipbuilding cranes were of $4\frac{1}{2}$- to $12\frac{1}{2}$-ton capacity, depending on whether the load was near the end of the cantilever arm or close to the runway.

The introduction of arc welding had a profound effect on the requirements for shipyard plant and equipment. The first 1,250-amp arc-welding generator set was installed in 1918, and in 1920 five such sets were put in operation. That was then the largest arc-welding station in any American shipyard. It put the Newport News yard into the business of building largely welded instead of riveted ships.

The adoption of the subassembly technique has removed from the shipways to the subassembly platens most of the time-consuming operations of





WITH MODERNIZATION COMPLETED Newport News shipyard has acquired new reinforced concrete pile-supported shipway No. 6 (which appears white just left of center) and new wooden shipway No. 7, just to right of it. Concrete shipway is type of construction believed to have no counterpart here or abroad. On each side of each shipway are whirler cranes and level platforms, or assembly platens, spanned by gantry cranes. Platens are built of 10-in. channels laid crosswise, and welded, backs up, to $^3/_4$-in. anchor bolts cast in 12 × 24-in. concrete sills resting directly on ground. Space of $^3/_4$ in. between channels permits runoff of rain water and provides space for attaching T-bolts for holding subassemblies during welding.

fitting and attaching the myriad of small parts that go into a ship's hull. Ocean-going vessels of the type built at Newport News grow ever faster and larger. Main turbines, reduction gears, boilers, and condensers have become heavier and heavier until many of these items now weigh from 50 to 100 tons per unit. Since hulls are constructed faster and generally are more complex, it has become desirable to install these units in complete form while the vessel is still on the shipway instead of assembling them in the vessel on the ways or waiting until after launching to put them aboard in the outfitting basins. To facilitate these modern operations, the new and rebuilt shipways and platens are laid out to include the following: Heavy cranes capable of putting aboard loads up to 100 tons; additional lighter cranes for picking up from the adjacent platens the lighter subassemblies and putting them aboard; enough gantry cranes to unload incoming materials and to serve the subassembly force on the platens; and shipways strong enough to support the maximum-size vessel during building, testing, and launching, where the launching weight may be as much as 15,000 gross tons.

The aerial photograph at the top of the first page shows the shipways section of the Newport News plant immediately before the modernization program here described was begun. To make room for the new crane tracks and platens, the two trestles nearest the semisubmerged ways were removed together with three of the older wooden shipways and the wooden pier to which the two ships shown in the background are tied up. The wooden shipway, No. 7, next to the semisubmerged shipways was repaired and remains, as may be seen from the photograph at the top of this page.

A cross section through the new concrete shipway, Fig. 1, shows the relation of the subassembly platens, gantry cranes, and whirler cranes to the new shipway. The 20-ton and 50-ton full revolving whirler cranes run on 171-lb crane rails, 30 ft apart, which rest on inverted T-type reinforced concrete beams supported on untreated green pine piles.

Experience in building the old shipways at the site indicated that piles 40 ft long could safely carry loads of 25 tons per pile, and the new design was based on this loading. The holding power of the soil proved to be extremely erratic. In a distance of 20 ft along some of the crane foundations, pile penetration under the hammer varied from refusal with a 6-ft cutoff to earth soft enough to require additional piles. Piles were green pine or fir, unpeeled, with a diameter 2 ft below the butt of not less than 12 in. and a diameter at the tip of not less than 7 in. They were driven with a 9B3 McKiernan-Terry or a No. 1 Vulcan hammer.

The 171-lb rails for the heavy whirler cranes and the 130-lb rails for the gantry cranes were thermit welded. These welded rails have gone through part of a winter and a full summer cycle with no sign of cracking or breaking and the concrete under the joints no longer pulverizes, as it did under the old bolted rail joints. There seems good reason to believe that the new type of construction will be successful.

Assembly Platens Built of Channels on Concrete Sills

The original subassembly platens were composed of steel plates on light railroad rails carried by timber cribbing resting on mud sills. There were serious operational objections to this type of design, and the life of the timber cribbing was short. To overcome these difficulties a platen was designed of steel channels laid backs up, and welded to $^3/_4$-in. anchor bolts cast in concrete sills resting on the ground, Fig. 1. Eleven continuous reinforced concrete slabs 2 ft wide by 12 in. deep were cast in place running parallel with the crane tracks. Into each slab on 11-in. centers a row of $^3/_4$-in.-dia anchor pins were cast. These hooked anchor pins extended $2^3/_4$ in. above the top surface of the concrete slab, approximately the depth of a 10-in., 20-lb channel. Extreme care was taken in pouring and finishing to make the top of the concrete slabs

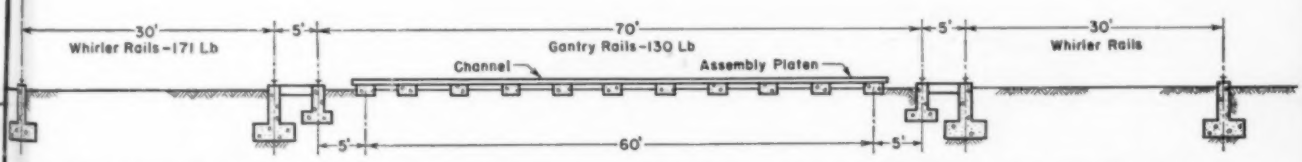


FIG. 1. SECTION across inboard portion of Newport News shipway project shows position of reinforced concrete shipway No. 6 between whirler cranes, which can conveniently pick up subassemblies from platens on outside and place them in vessel on the ways. Subassembly platens are served by gantries.

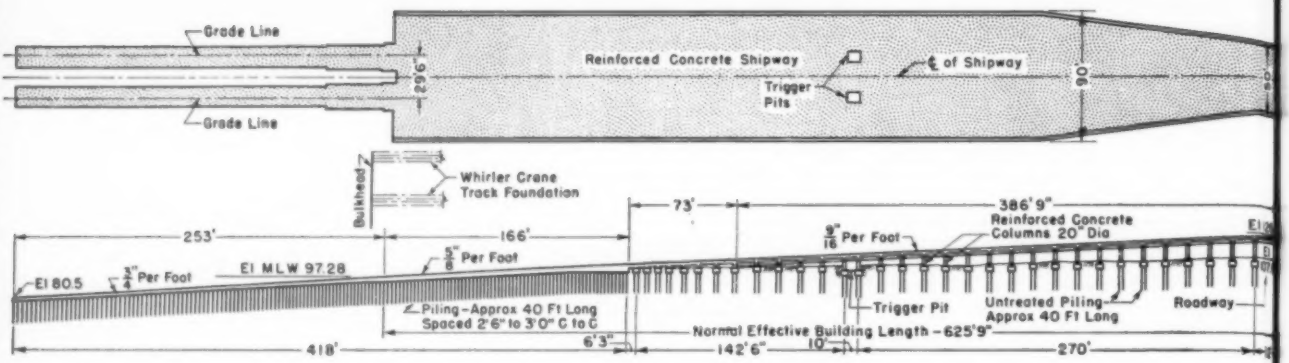


FIG. 2. SHIPWAY No. 6 consists of 18-in. reinforced concrete slab supported on wooden piles and sloping downward from about 30 ft above water at inboard end to 18 ft below at outboard end.

level. After the concrete had set, the channels were placed with their backs up across the platen at right angles to the crane tracks. When the height had been carefully adjusted, each channel was welded to the anchor pins on each side.

Choice of the steel channel design gave the following advantages: The $^{3}/_{4}$-in. space between channels permits rain water to run off quickly; the area of the reinforced concrete slabs is sufficient to prevent settlement under any anticipated concentration of loading; the life of the concrete and steel channels will be long compared to that of timber; by using $^{3}/_{4}$-in. anchor pins on 6-ft centers parallel to the channels, heavy uplifts can be resisted; and by inserting T-bolts between adjacent channels, and attaching holding-down pads to them, certain of the subassemblies can be pulled into shape quickly and cheaply and held there for welding.

Loads on Keel Track Heavy

Under the various classification bureaus and Navy Specifications all ship compartments that are designed to be watertight must be tested in the course of construction by being filled with water to check for leaks and to prove that the bulkheads and even the decks will not collapse under the full water head. Many of these compartments are large and while it is customary to fill them one at a time, the weight of the vessel and water together can impose very high loads on the shipway structures, especially when combined with loads from machinery installed before launching such as boilers, turbines, and reduction gears. The heaviest loading condition, however, occurs during launching for the type of vessel which the dimensions of the shipway limits to about 90-ft beam, 675-ft length and a launching weight of 15,000 tons. The weight of the ship during launching is carried by two launchways approximately 7 ft 6 in. wide in order to limit the pressure on the launching grease to 2 tons per sq ft. The launchways are placed from 24 to 32 ft apart, from center to center, depending on the type and beam of the ship.

MIDDLE SECTION OF SHIPWAY carries heaviest loads, as it is here that bow of vessel being launched exerts concentrated load when stern first hits water, leaving middle of keel unsupported. Shipway here consists of heavy reinforced concrete slab resting directly on piles. See Fig. 2, above.

The heaviest pressure on the ways occurs during launching as the ship enters the water stern first. As the stern begins to be lifted by the buoyant effect of the water, an increased load is thrown on the launchways where they are in contact with the bow, since all the weight comes at that one point instead of being evenly distributed throughout the length of the vessel.

The declivity of the shipway (Fig. 2) is $^{9}/_{16}$ in. per ft from the inshore end to a point approximately 98 ft inshore from the steel sheetpile bulkhead which serves as a retaining wall at each side of the shipway; $^{5}/_{8}$ in. per ft for the next 95 ft; and $^{3}/_{4}$ in. per ft on the outshore and submerged end, a distance of approximately 250 ft. The actual load on each launchway is 15 long tons per ft to what is known as the pivoting point, where it increases uniformly to a maximum of 48 long tons per ft, decreasing again to 24 tons, where it remains until the end of the outboard structure, at which point the ship is fully afloat.

The declivity of the new concrete shipway was made the same as exist-

ing shipways in order to use launching ways and equipment already on hand. The declivity of the original ways was established by naval architects after launching experience with ships of comparable weight to those for which the new ways were designed. In general the starting grade was chosen as steep enough to start the ship moving on the grease, and the increase in declivity, or cambering of the ways, was used to shorten the length of the ways and at the same time decrease the way-end pressure by causing the ship to be water-borne sooner.

Concrete Ways Expected to Have 50-Year Life

The decision to build a concrete shipway was based entirely on economics. The unprecedented demand for lumber during World War II resulted in a rapid increase in cost, particularly in the larger sizes of 12 × 12, 12 × 14, and 12 × 16 Oregon pine timbers used in this type of construction and embodied in the rebuilt Shipway No. 7 alongside of No. 6. Reinforced concrete has also increased in cost but not to the same extent. However, the determining economic factor was maintenance. The first cost of wood and that of reinforced concrete were about comparable, but the life of the concrete superstructure was believed to be at least 50 years as compared to 8 or 10 years for wood. (At least the wood structure would require heavy repairs after this period.) Another important factor considered in the selection of reinforced concrete was the fire hazard always present in unprotected wood construction.

INBOARD SECTION of reinforced concrete shipway, varying in height from ground level to 18 ft above, is carried on 275 reinforced concrete columns of 20-in. diameter, supported on concrete bents resting on piles. At left of shipway can be seen completed assembly platen formed of 10-in. channels laid with space of $^3/_4$ in. between them.

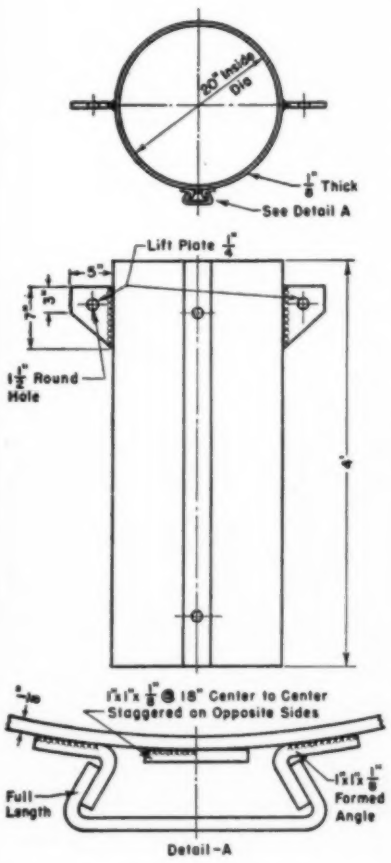


FIG. 3. REINFORCED CONCRETE COLUMNS of 20-in. inside diameter support upper end of shipway. See longitudinal cross section in Fig. 2. Same forms were used for all columns, regardless of height. As here shown, forms consisted of 11-gage ($^1/_8$-in.) welded steel cylinders held with vertical clamp in Detail "A." Joints were welded all around on outside. Forms were built up of 4-ft sections for high end and were burned off as height of columns decreased with downward slope of shipway.

At the inboard end of the shipway for 390 ft, the required height was obtained by supporting the upper structure on 20-in.-dia reinforced concrete columns spaced as shown in Fig. 1. These columns were originally designed in three sizes to support loads varying from 77 to 189 tons each, taking into account the varying heights. For economy in form utilization, however, all columns were made 20 in. in diameter but with varying amounts of reinforcing steel.

The circular forms were made up of 11-gage metal with the clamping device shown in Fig. 3. As the work progresses seaward, requiring successively shorter forms, the ends were burned off, permitting the same forms to be used many times. In this section 24 in. built-up structural columns salvaged from the old trestles were set as longitudinal girders 60 ft long, designed as continuous beams. Also located in this section is the trigger pit, which holds the two triggers and their operating mechanism for launching vessels.

This flat-slab and column construction is followed by 73 ft of a 15-in. slab carried by reinforced concrete girders resting on 32-in. pile caps, 46 ft 6 in. long.

The construction then changes (for the next 166 ft) to a flat slab resting directly on the piling. It is in this section that the highest stresses occur during launching. The slab is 30 in. thick and is heavily reinforced top and bottom, since under certain conditions it undergoes a reversal of stresses.

From this point to the end of the ways, 253 ft beyond the inshore end, two flat slabs 14 ft 6 in. wide, resting directly on piles, distribute the weight from the launching ways. The slabs slope inward and downward toward the longitudinal center line on a grade of $^3/_8$ in. per ft and the thickness decreases to a minimum of 18 in. at the extreme outboard end.

No expansion joints are provided. The angular displacement of the concrete columns due to expansion was calculated to be less than enough to

cause cracks. Over a period of six months' expansion, has been negligible. A recent check showed a total longitudinal movement of the shipway of $1^3/_8$ in. at 24 deg F. Two openings 7×9 ft, provided above the trigger pit for the operating levers of the triggers, are large enough to provide for a shift in the location of the trigger as may be required to suit individual ships.

To afford anchorage for pulling against the concrete deck while a ship is in process of fabrication, 6-in. structural channels on 10-ft centers were embedded in the concrete deck of the shipway and anchored toe down, with the heel flush with the concrete deck, running from the keel track to within 4 ft of the curb wall. The outboard ways are provided with longitudinal slots 10 in. wide by 5 in. deep, and about 20 ft apart, to serve as an anchorage for the launchways, which must be anchored in place against lateral displacement.

Underwater Section Poured in Cofferdams

Construction of the outboard section with the help of a rectangular steel sheetpile cofferdam was the most difficult part of the work. After dredging to approximately the required depth, a cofferdam was driven consisting of DP2 sheetpiling interlocked with the steel sheetpile bulkhead inshore on each side of the shipway. The cofferdam was then unwatered; the wood foundation piles were driven, excavated to grade, and cut off to elevation; the forms and reinforcement were set; and the slab was poured.

The sheetpiling was removed except for the outboard line, at the ends of which corner posts had been driven. The sheetpiling for the second cofferdam, extending 90 ft further out than the first, was then driven and interlocked with the steel in place in the seaward end of the first cofferdam. Unwatering and driving of wood piles followed.

At this stage, it was discovered that the driving of the wood piles in the second cofferdam had caused some upheaval in the recently poured shipway slab in the area covered by the first cofferdam. This upheaval reached a maximum of about $1^1/_4$ in. about 10 ft inboard of the sheetpile wall common to both cofferdams. Evidently the closely spaced piling had compressed the substratum in the whole immediate neighborhood, causing an uplift greater than the weight of the concrete slab, piling, and adhering soil.

To minimize the danger of further upheaval, the remainder of the wood piling on the outboard section was driven under water. When no further upheaval was noticed, the section of ways contained in the second cofferdam was unwatered and poured.

In driving the third and last cofferdam, about 90 ft long and the same width as the other cofferdams (52 ft), the seaward end of the second cofferdam was utilized for one side. Some rough weather was encountered in this section and the cofferdam had to withstand a water pressure due to a head of about 20 ft. The cofferdam had two lines of waling consisting of 73-lb 14-in. wide-flange beams with diagonally horizontal braces at the third points across each corner and cross bracing. Pouring of concrete in this cofferdam was completed three days after unwatering, speed being necessary because rough water was encountered and it was feared that the cofferdam might have to be flooded to stabilize it and prevent damage due to wave action. The sheetpiles were drived to a penetration of 22 ft but soupy mud was encountered in the bottom and a mat of gravel had to be deposited inside the cofferdam to compact the base for pouring the concrete.

After pouring was completed in the third cofferdam, the outboard portion of cofferdam No. 1 was redriven to correct the grade of the concrete altered by the upheaval previously described. The concrete was chipped off to the required elevation by pneumatic hammers.

Cost Data on Shipway

The cost of the concrete shipway alone was about $650,000, and that of the whole project here described was just under $3,500,000. The shipway was completed in June 1949 and the entire program in October 1949.

Design and detail drawings for the project were made by the Plant Engineer's Office of the Newport News Shipbuilding & Dry Dock Co. The McLean Contracting Co. of Baltimore, Md., was the contractor on the work, including erection of cranes. The whirler cranes were manufactured by the American Hoist & Derrick Co. and the gantry cranes by the N.N.S. & D.D Co.

FOREST OF PILES supports reinforced concrete shipway No. 6 for entire length. In view below, left, piles are being driven in right foreground while in center foreground heavy concrete slab, reinforced top and bottom, is being constructed directly on piles to carry shipway's heaviest launching loads. Bulkhead line is at far left. Beyond bulkhead line three steel sheetpile cofferdams were constructed successively outward, and in them piles were driven and concrete ways poured. In view below, right, sheetpiles are being pulled in third or outermost cofferdam on completion of shipway paving. Rough water demanded completion of work in outermost cofferdam in three days, to avoid need for premature flooding to prevent damage. In right foreground, note salvaged steel beams for inboard section of shipway, which rest on reinforced concrete columns, in turn carried by concrete bents on wooden piles.

Engineers' Notebook

Cyclic Variations in Columbia River Flow Studied

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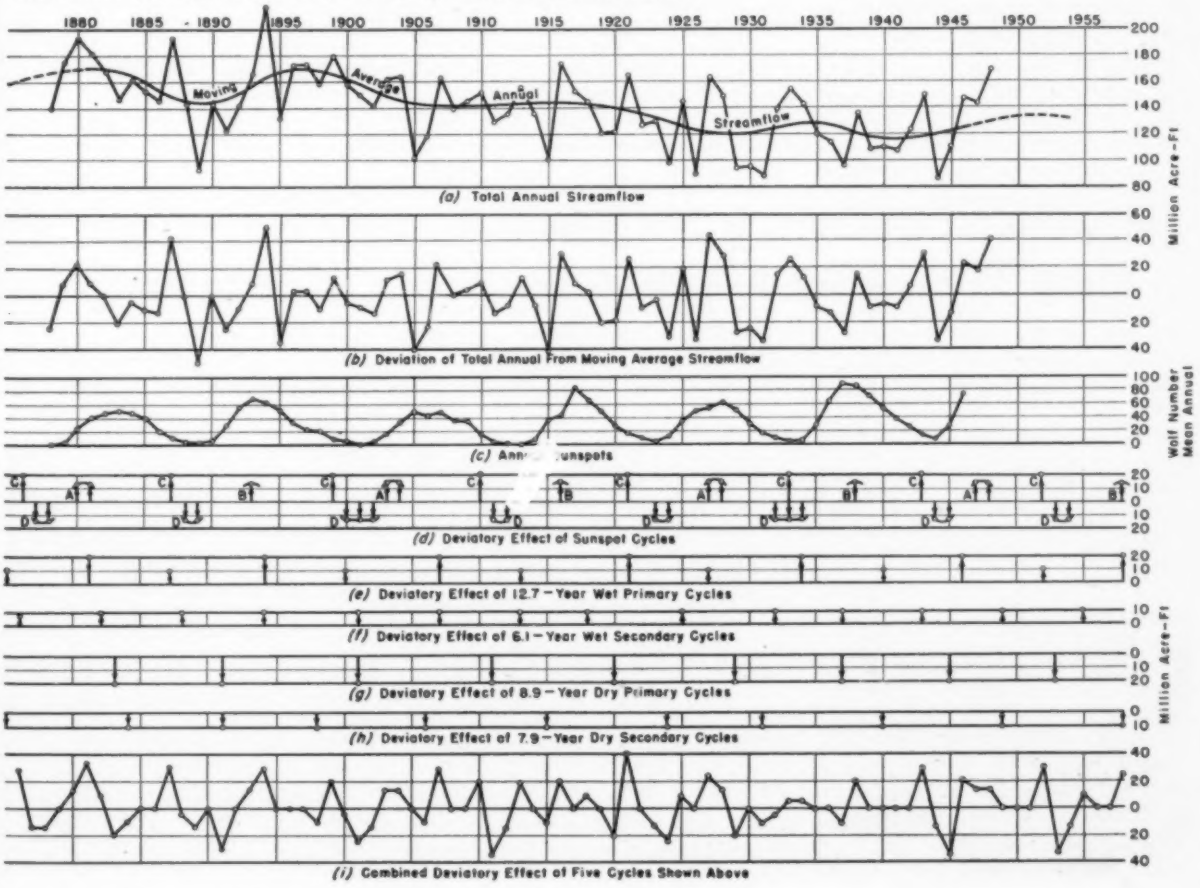
ABILITY TO PREDICT the seemingly capricious flow of the Columbia River would be very advantageous now that this river has become the most important "power stream" in the United States. The types and numbers of cycles influencing climate and stream flow probably are legion. The most important as well as the best known of the shorter cycles is the sunspot cycle or Hale cycle of 11.1 years, the average since astronomers first began to measure sunspot activity in 1749. The double sunspot cycle of 22.2 years has been found to have a greater effect on climate and stream flow than the single sunspot circle.

Stream flows of the Columbia River, which constitute the basic data used in this study, were taken from the Water Supply Papers of the U.S. Geological Survey. Total stream flows, in acre-feet per calendar year, as measured at The Dalles, where the drainage area is 237,000 sq miles, are plotted as points on a graph for the entire period of record, 1878 to 1948, in Fig. 1 (*a*). The 71-year average flow is 141,000,000 acre-ft per calendar year (194,700 cfs), with a high of 221,900,000 in 1894 and a low of 86,127,000 acre-ft in 1944. The smoothed approximate seven-year arithmetic moving average streamflow, also shown in Fig. 1 (*a*), dropped

FIG. 1. SYNTHETIC STREAM-FLOW CYCLES for Columbia River (*i*), developed by writer, show good general agreement with actual stream flow, (*a*), except in a few cases. Deviations may be used to predict future flows. In (*i*) synthesized effect of cycles is extended to 1958, indicating a large flood in 1952, followed by two years of severe drought.



from about 160,000,000 acre-ft in the first 20 years plotted to 120,000,000 acre-ft in the last 20 years, or a decline of 25 percent, reflecting a decided change in climate.

For certain short periods, this "moving average annual line" may be considered to be the theoretical average around which the actual annual values fluctuate. If this line is considered as a horizontal baseline, and around it are plotted the differences between it and the actual values, there results a picture of "deviation of total annual from moving average stream-flow," Fig. 1 (*b*).

Cyclic Correlation Is Matter of Trial and Error

The work of correlating stream flow with cycles is mainly a matter of trial and error, and perhaps personal judgment. The longer the period of record, the more points of comparison and the better the chance of success. In the case of the Columbia, the writer was greatly aided by the studies of tree rings in the Northwest made by the Department of Agriculture in 1937. The tree-ring records cover several hundred years but nevertheless should be used conservatively. Very good agreement has been found between stream flows and tree rings on the one hand and sunspot activities on the other hand as far back as 1749, the double-double sunspot cycle (44.4 years) being more pronounced. Complete correlation involves a combination of all cycles.

Sunspot activities as reported in mean annual Wolf numbers are plotted in Fig 1 (*c*). The cycles discovered by the writer through trial and error in the stream-flow study and by comparison with tree-ring records are as follows:

1. 12.7-year wet "primary" cycle with a 6.35-year subcycle
2. 6.1-year wet "secondary" cycle
3. 8.9-year dry "primary" cycle, with every fourth cycle slightly more pronounced.
4. 7.9-year dry "secondary" cycle.

Figure 1, (*d*) to (*h*) inclusive, shows the effect of these cycles. As determined by trial, there has been assigned to each cycle a length of time its effect is noticeable, and its deviatory effect from the moving average is given in millions of acre-feet.

In Fig. 1 (*i*) the synthesized effect of all four cycles is shown, computed by arithmetic addition, for each year and extended to 1958. The deviations may be used to predict future flows, and it may be of interest to note indications of a large flood in 1952, followed by two years of severe drought.

A comparison of (*b*) and (*i*) indicates remarkable agreement between the actual curve and the synthetic curve. Major differences occur only for the years 1895, 1905, 1926, and 1930. It is quite possible that these years would fit into some longer and more obscure cycle. For instance, the moving average line itself appears to follow a vaguely distinguishable cycle of $16^2/_3$ years.

Cycles Are Never of Exactly Same Length

It may be noted that the space between the points of effect of the cycles in (*d*) to (*h*) inclusive is not shown equal to the theoretical period of the cycle. The reason is that the cycle is a long-time average; actually no two cycles are ever exactly of the same length. Also, cycles must conform to the seasons and to other patterns of the locality. Thus, on the Columbia River, all wet cycles must coincide with the three wet months of May, June and July and consequently may be shifted some 6 to 9 months from their theoretical average. The same is true of dry cycles, which effect a proportionately greater reduction of flood flows than they do of low flows.

Further study may lead to the discovery of additional cycles, by those of the profession engaged in detailed planning and design work on the Columbia River, leading to improvement of the general principles here presented.

Flow-Net Construction Simplified by Using Principle of Magnetic Field

H. E. HURST and S. LELIAVSKY BEY, M. ASCE

Respectively, Scientific Consultant, and Director, Designing Service, Reservoirs and Nile Barrages, Ministry of Public Works, Cairo, Egypt

MANY PRACTICAL PROBLEMS of hydraulic, structural, and electrical engineering can be solved by means of flow-net diagrams. Trajectories of principal-stress intensities and seepage through granular dam foundations are probably the most familiar applications in the civil engineering field. However, the construction of a flow net by purely analytical or experimental methods is frequently difficult and laborious. The method of flow-net construction here presented enables an approximate diagram to be drawn with a small expenditure of time and labor.

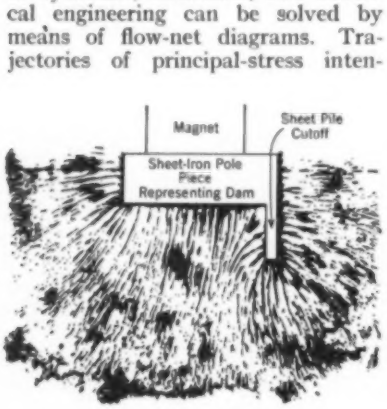
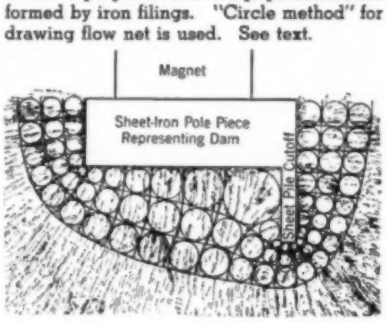


FIG. 1 (LEFT). LINES OF CONSTANT HEAD, or equipotential lines under a dam are formed by iron filings on sheet of blueprint paper placed over magnet and sheet-iron form. Gently tapping paper causes filings to take position shown. Exposure in ordinary daylight for proper length of time brings out image when paper is developed.

The idea is to replace the equipotential lines and lines of flow in the problem by lines of magnetic force and potential or vice versa. All the equipment needed is one or two magnets and some sheet iron. The magnets may be ordinary bar magnets or an electromagnet—which can be easily energized by a car battery or by the small cells used in radio work.

To illustrate the method, take the

FIG. 2 (BELOW). FLOW NET for case of percolation under dam with sheetpile cutoff, is drawn perpendicular to equipotential lines formed by iron filings. "Circle method" for drawing flow net is used. See text.



case of percolation under a dam, as shown in Fig. 1. The sheet-iron form represents the floor of the dam, built on a permeable foundation with a single sheetpile at the right edge to act as a cutoff. The arrangement of magnet and sheet iron is laid on a table and covered with a sheet of blueprint paper. Iron filings are sprinkled on the paper and made to set themselves along the lines of magnetic force by gently tapping the paper. This is done in ordinary daylight and the paper is left undisturbed long enough for a print of the filings to be formed. Next, the paper is developed and the image brought out, as shown in Fig. 1.

Flow Net Drawn by Circle Method

A flow net is then drawn from this image by the "circle method," as shown in Fig. 2. The circle method is a refinement of Forchheimer's method, in that his chain of approximate squares is modified to be a chain of tangent circles or a series of such chains wherein all circles are tangent to contiguous circles. (See "Graphical Methods for Flow-Net Diagrams," Parts I and II, S. Leliavsky Bey, M. ASCE, *The Engineer*, May 14, 1948, pp. 464–465, and May 21, 1948, pp. 488–490.) The tangent lines outlining the chains of circles form the flow net. The use of circles in place of Forchheimer's approximate squares simplifies the procedure of drawing the flow net and eliminates errors due to the personal equation of the draftsman.

In the magnetic case the boundary of the sheet-iron pile piece is an equipotential surface. In the percolation case the boundary of the dam section is a line of flow and the filings indicate equipotential lines or lines of constant effective head. The lines of flow are drawn perpendicular to these equipotential lines.

The equipotential surface representing the river bed is the horizontal line of filings shown dashed in Figs. 1 and 2. The sheet-iron form can be built up of separate pieces so that, for example, the effects of different positions of the sheetpile or of several sheetpiles can be tried very quickly, and the sun print gives a record of each case, which can be filed for reference.

A little ingenuity is sometimes required to make the build-up of the pole piece fit the problem. If desired, the perpendicular lines, that is, the lines of flow, on the blueprint can be drawn in India ink and the paper bleached by immersion in a dilute solution of caustic soda.

... THE READERS Write

Procedure on New Constitution Censured

TO THE EDITOR: In the story of the business meeting at the Annual Meeting of the Society on January 18 in the February issue of CIVIL ENGINEERING, it is stated that:

"A motion from the floor to return the proposed new Constitution to a committee for further study was declared out of order, but the Chair twice announced that he would entertain a motion to postpone sending the proposed new Constitution to ballot until after the Summer Meeting. No motion to postpone was forthcoming. The proposed new Constitution will now go before the membership for adoption by letter ballot."

Having made the motion that was ruled out of order by President Howard, we desire to add the following comments for the record.

In our opinion and that of a number of other ASCE members who have studied the Constitution, President Howard erred when he ruled the motion to refer the Proposed Revision to a committee out of order. Such a motion is in accord with the provisions of Section 4 of Article 10 of our Constitution which states:

"If, after discussion of a proposed amendment, at either of the general meetings of the Society, the meeting shall so decide by a majority vote, it may refer the amendment to a Committee for further consideration, which Committee shall report at the next general meeting, whereupon the amendment shall be voted upon as hereinbefore provided."

Furthermore, we can find no Constitutional authority for the alternate proposal "to postpone sending the proposed new Constitution to ballot until after the Summer Meeting." Our Constitution does not provide for a mere postponement of action and, in our judgment, no action could have been legally taken at the business meeting other than to refer to a Committee as moved by the undersigned. Such a referral would have given time for consideration by Local Sections so that probably the controversial points in the Proposed Revision could have been ironed out to the satisfaction of the membership. That was the objective of our motion.

Another ruling with regard to our Constitution that we believe to be in error has come to our attention since the Annual Meeting. This has to do with the matter of substitution of the grades recently recommended by ECPD for present membership grades. We are reliably informed that, shortly before the business meeting, a high officer of the Society ruled that it would not be pertinent to offer this as an amendment at the business meeting because it would be such a major change that it would not be Constitutional. What is pertinent and what is not is, of course, a matter that is subject to interpretation, but since the whole Constitution is being considered for revision, it would seem that it would have been pertinent and legal to have brought up not only membership grades but any other matter covered by the Constitution.

Those who are advocating a new Constitution have criticized our present Constitution, in our opinion and for the most part, without just cause for doing so. The experiences which we have cited seem to indicate a degree of unfamiliarity on the part of these proponents with our generally excellent present Constitution. This Constitution was prepared about 30 years ago after much careful study and has served the Society well through its period of greatest growth. In the light of present Society conditions, minor revision in some particulars may be desirable, but a major revision as proposed containing so many apparent defects is certainly not in the best interests of the Society.

The news report in February CIVIL ENGINEERING states that the new Constitution "will now go before the membership *for adoption* by letter ballot." Are we to assume that the members of ASCE are to have no choice in the matter? In a recent letter to the undersigned, President Howard stated, "I respect your right to think and to vote," which indicates that our President concedes to each of us the right to vote for or against adoption. CIVIL ENGINEERING, the official Society magazine, should do likewise and should

be available to all ASCE members to present both sides of controversial issues. In addition, news reports should not be slanted in favor of one side or the other.

ALBERT S. FRY, M. ASCE
Knoxville, Tenn.

The New Constitution Committee makes the following comment on Mr. Fry's letter:

1. The ruling to which objection is now raised was not protested by Mr. Fry at the time it was made. Ample opportunity for such protest was afforded by the chairman. In any event, the meeting procedure has no relation to the question of whether the proposed constitutional amendments are good or inadequate. They must be voted on their merits.

2. In the opinion of ASCE legal counsel, an amendment to change the membership grades could not be adopted by the meeting because (in the words of the present Constitution) it would not be "pertinent to the original amendments" which had been sent to the members.

3. It is not a "major" revision of the Constitution that is now proposed. On the contrary, major and fundamental changes are carefully avoided. The objectives are merely to improve the existing Constitution in conciseness and clarity; to exclude phraseology not essential to a constitution but more properly belonging in the by-laws; and to delete a few instances of conflicting language that led to requirements that were impossible to fulfill. In the Committee's opinion the resulting revisions are minor, not major. Opposition to them seems surprising and ill-founded.

4. The wording in the February CIVIL ENGINEERING that the new Constitution "will now go before the membership for adoption, etc." was, of course, an oversight. It should have read "for adoption or rejection."

Reports 11-Deg Upward Inclination of Wind

TO THE EDITOR: In my article, "Wind-Tunnel Tests Reveal Serious Inadequacy of Present Bridge Specifications" (CIVIL ENGINEERING, October 1947), I emphasized the necessity for observational data on the range of wind inclination to assume for safe design, and added: "Until more conclusive information is available, it would appear hazardous to assume that the wind is always horizontal; and for safe design, an assumed potential range of ±12 deg of wind inclination is suggested."

Through the courtesy of Prof. A. Müllenhoff, I have now received specific confirmatory information from Germany. Observations made by Dr. Frankenberger, official meteorologist, on the wind intensity and direction at different elevations of a high overseas radio mast near Hamburg show that quite often the wind has an upward inclination of as much as 11 deg.

In 1948, Dr. P. O. Huss, Chief of the Meteorological Research Division of the Daniel Guggenheim Airship Institute at Akron, reported to me his observations on wind inclination and velocity at different levels of a 350-ft tower. His values of the maximum inclination angles ranged from 8 to 29 deg, all positive (upward). Apparently no negative or downward inclinations of the wind have ever been reported.

Additional observational data are still needed.

D. B. STEINMAN, M. ASCE
Consulting Engineer

New York, N.Y.

Standard Specifications Can Lower Dam Costs

TO THE EDITOR: Ross White's statements that present-day dam specifications could be modified without appreciably affecting the end result, in his paper in CIVIL ENGINEERING for February 1950, are indeed timely. As a construction engineer who has headed the contractor's engineering organization on two recent major dam projects—Bull Shoals Dam and currently Detroit Dam—I concur heartily.

He omitted to mention the fact that there are frequently differences of opinion among the various districts of the principal government contracting agencies. On practically identical work one district will permit certain construction practices while another district will prohibit them. This seems unfair to the constructor. In many instances it means radical changes in construction plant, all tending to increase costs. Contractors sometimes take for granted that certain practices will be permitted because of their prior application, only to be faced with the old argument, "You had better go read the book."

Specifications could and should be more standardized, as Grant Bloodgood stated in his article in the same symposium. This has been done with certain Bureau of Reclamation specifications. Standards could easily be confined to general subjects such as drilling, blasting, excavation, embankment, foundation preparation, mass concrete, including mixing, placing, cleanup, curing and protection, reinforcing steel, and embedded items. With such standardization, the constructor would be able to delete sums for contingencies usually added to cover variations in permitted practices, thereby lowering the cost of the work.

We are in the midst of the greatest era in major construction history. Surely now is the time to direct everyone's efforts toward reducing construction costs. Lower costs can be realized if we adjust our sights on such matters as concrete temperature control, form lining, bucket restrictions, height differentials, manufactured versus natural aggregates and the many other penalizing features of present-day major construction contracts. Sponsor engineers should join with contractor engineers on a solid front to achieve this goal.

H. H. ROBERTS, *Chief Engineer, Consolidated Builders, Inc., Detroit Dam Project*

Mill City, Ore.

More Knowledge of River Regimen Theory Needed

TO THE EDITOR: With reference to the conclusion of J. C. Stevens' article, "Aggradation in Rio Grande Valley Affects Sedimentation of Elephant Butte Reservoir," in the February issue, it is unfortunate that river regimen theory has received so little attention in the United States. Principles of river regimen were developed by Gerald Lacey in India in the late 1920's and were described by him in the *Proceedings* of the Institute of Civil Engineers, London, Vol. 229, 1929; Vol. 237, 1933–1934; and *Journal* of the I.C.E., Vol. 27, 1948. His theory has been generalized by the writer to explain the effect of cohesive sides of channels ("Théorie de l'Écoulement Turbulent," *La Houille Blanche*, May 1946). The data used in the latter article were obtained by the writer (formerly Director of Irrigation Research, Punjab) from many sediment-bearing canal systems, excavated in alluvium and carrying a sediment load similar to that of the Colorado River.

The impetus to study these phenomena arose from the futile efforts of engineers from the 1880's till the 1920's to make canals run to arbitrary widths, depths and slopes which either were unsuited to the sediment load or caused erosion of the banks. The scope of Lacey's studies can be evaluated from the fact that the Punjab Province alone, with some 70,000 cfs

(*Continued on page 80*)

SOCIETY NEWS

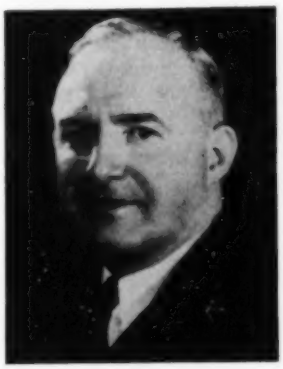
Have You Voted on Proposed Revision of Constitution? Ballots Will Be Counted April 19, 1950

Francis Friel Succeeds Joel Justin as ASCE Director, District 4

FRANCIS FRIEL, PHILADELPHIA consultant, has been appointed by the Board of Direction to fill the unexpired term of ASCE Director Joel Justin, who died on February 21. Long active in Society work, Mr. Friel has been a full member since 1926. While serving as president of the Philadelphia Section in 1946, he headed the committees in charge of the highly successful Spring Meeting of the Society.

A graduate of Drexel Institute, class of 1914, Mr. Friel was with the Philadelphia Bureau of Surveys until 1917. Entering the Army Corps of Engineers in the latter year, he filled various wartime engineering assignments in this country and was 14 months overseas with the AEF, commanding an Engineers company on the Western Front. After the war he became structural engineer for the Emergency Fleet Corp. on research and the construction of concrete ships. Later he was designing engineer for the Philadelphia Bridge and Sewer Division, and was in the design and Construction Section of the Pennsylvania State Department of Health at Harrisburg.

Since 1922 Mr. Friel has been in consulting work in Philadelphia—first as engineer in charge of a variety of construction projects for the firm of Albright & Mebus, and from 1931 until recently as vice-president, treasurer, and chief engineer of the successor firm of Albright & Friel. He is now president and treasurer of the firm. During the three-year period, November 1940 to December 1943, he was in charge of the design and construction of twelve Army and Navy projects valued at over $36,165,000.



FRANCIS FRIEL
ASCE Director, District 4

An expert in the sewerage and water supply fields, Mr. Friel is the author of numerous articles on water, sewage, industrial waste, and refuse disposal problems. He has also been active in organizations devoted to study and work in these fields, including the American Water Works Association, the American Public Works Association, the Pennsylvania Water Works Association, the Pennsylvania Sewage Works Association, the Maryland-Delaware Water and Sewage Association, and the Federation of Sewage Works Associations. Mr. Friel served the latter organization as director in 1943 and as president in 1947.

Tacoma Section to Be Host to Second Annual Pacific Northwest Conference

LICENSING PROCEDURES, PROFESSIONAL ethics, and engineering education will be the major topics of discussion at the second annual Pacific Northwest Conference of Local Sections, to be held in Tacoma on Friday and Saturday, May 5 and 6. The program, arranged by a committee of Tacoma Section members headed by John Stackhouse as conference chairman, calls for registration at 4:30 p.m., Friday, followed by dinner and the annual conference business meeting.

The Local Section Conference, scheduled to begin at 8 p.m., will consist of a symposium on professional registration in the Pacific Northwest, with former ASCE Vice-President John W. Cunningham representing Oregon, and speakers of similar qualification for Washington and Idaho. Cecil Arnold and Leland Sphar, of the Seattle Section, will then discuss the subject, "Does the Code of Ethics Need Revision," basing their talk on a special committee report on the subject recently submitted to the Section. The topic, "Education of the Engineer," presented by Guy Taylor, of the Oregon Section, will have to do with possibilities for education after graduation rather than with undergraduate curricula.

Saturday morning will be devoted to a series of descriptive talks on the Tacoma Narrows Bridge and related topics with Charles E. Andrew, consulting engineer on the structure for the Washington Toll Bridge Authority, acting as moderator. An afternoon field trip to the new Tacoma Narrows Bridge Project, which will be at an interesting stage of construction with stiffening truss erection well advanced, will supplement the morning program. Other Saturday events will include a general luncheon, with Roderic Olzendam, director of social security for the State of Washington, as principal speaker, and a dinner dance and general get-together in the evening. Special entertainment will be provided for the ladies.

Requests for reservations should be sent directly to the Hotel Winthrop, headquarters for the conference.

Northwestern Students Plan Annual Meeting

THE 1950 NORTHWESTERN STUDENT Conference will be held at Montana State College, Bozeman, on May 5, according to an announcement from John S. Mead, program chairman. Culminating feature of a three-day field trip to Hungry Horse Dam and other Montana projects, the conference will represent Student Chapters at the universities of Washington and Idaho, Washington State College, and other engineering schools, in addition to the host Chapter. President of the 1950 conference is Albert N. Kraft, of Bozeman.

Los Angeles Section Makes Final Plans for Spring Meeting, to Be Held April 26–29

As announced in previous issues of Civil Engineering, the Los Angeles Section has arranged a Spring Meeting program of technical sessions, inspection trips, and social events designed to appeal to a variety of interests and tastes. In addition to the long list of scheduled inspection trips, ranging from a boat tour of the Long Beach and Los Angeles harbor installations to an all-day visit to the celebrated Mt. Palomar Observatory, engineers visiting Los Angeles will have numerous informal opportunities to study the extensive engineering and industrial development of the area. All tours will involve transportation over a network of arterial highways being built by the State of California in an ambitious program to reduce traffic congestion in metropolitan centers.

More than 600 students from engineering colleges as far afield as the universities of Colorado and New Mexico are planning to attend the meeting, which will combine the events of the Third California Conference of Local Sections. The student program will include the traditional technical paper contest, a Student Chapter Conference and luncheon, and an all-day program of inspection trips.

From the Junior Forum of the Los Angeles Section comes announcement of final arrangements for the Junior Luncheon, to be held in the Embassy Room of the Ambassador on Thursday, April 27. Following luncheon, which will be $2.80, Warren Curtis, Junior Forum president, will welcome the group. A M Rawn, chairman of the ASCE Committee on Salaries, will present the feature talk on "What the Employer Wants from the Young Engineer." The functions of the Society's Committee on Juniors will be explained by John G. Girand, vice-chairman of the committee.

Announcement of plans for the Wednesday Construction Luncheon has also been made. Speakers scheduled to appear in a panel discussion on "The Construction Outlook" include Charles H. Purcell, director of the State Department of Public Works; George Atkinson, president of the Guy F. Atkinson Co., San Francisco; and Col. W. D. Luplow.

OBJECTIVE OF one of Spring Meeting inspection trips will be $41,000,000 Hyperion Sewage Treatment Plant now under construction for City of Los Angeles. With capacity of 245,000,000 gpd of sewage, project will be largest high-rate activated sludge plant in the country. View at left shows east battery of aeration system. California engineers are utilizing curved ramps supported by single-column bents in freeway construction (lower photo).

ENGINEER VISITORS TO LOS ANGELES will be interested in city's tremendous industrial development. View at left shows huge aggregation of oil-well derricks, storage tanks, and loading quays in Long Beach Harbor. One of high-octane gasoline refineries that make Los Angeles environs one of the largest gas-refining areas in the world is pictured at right.

Cost of ASCE Group Disability Insurance Plan Is Lower Than Individual Cost

A NUMBER OF Society members have asked why it is that they can buy accident and health protection under the ASCE Group Disability Insurance Plan at a lower cost than they would have to pay as individual purchasers. After two years of committee study, the present plan was presented to the Board of Direction. At the request of the Board, George S. Buck, consulting actuary of New York City, examined the proposal from an actuarial viewpoint and reported favorably before the plan was approved by the Board. The following excerpts, quoted verbatim from his report to the Board dated October 29, 1948, provide some answers to questions of relative cost.

THROUGHOUT THE COUNTRY there is wide coverage of employees under group policies that provide sickness, accident, and death benefits, where low premium rates are obtainable because a stable group having a common employer is established. Under the proposed plan, the idea of group coverage is extended to persons who are members of an organization, and although individual policies are issued to the members participating, the premium rates are quoted on the "wholesale basis." This basis offers premium rates which are higher than the rates computed on a group basis for persons having a common employer, but are lower than the rates obtainable by an individual purchasing his own policy. In other words, the members of an association are considered a sufficiently select and stable group to permit premium rates that are more favorable than those offered to an individual but not as favorable as the rates for a group having a common employer.

Disability insurance is issued under individual policies largely on the basis that the insurance company may cancel the policy and is not required to continue it indefinitely, which may be a serious loss for a policyholder who needs the coverage and cannot buy it elsewhere because his health has become impaired. The coverage offered under the proposed plan is of the non-cancellable type so far as an individual member's policy is concerned since the insurance carrier does not reserve the right to cancel the policy of a particular individual. However, the coverage is cancellable by the insurance carrier with respect to all members participating in the plan, for upon 60 days written notice prior to the renewal date of the policies the insurance company may decline to renew the policies of all participants. You will of course understand that an individual policy would be cancelled because of non-payment of premium, or when the insured reached the maximum age of 70 years, or could be cancelled if the insured ceased to be a member of the Society.

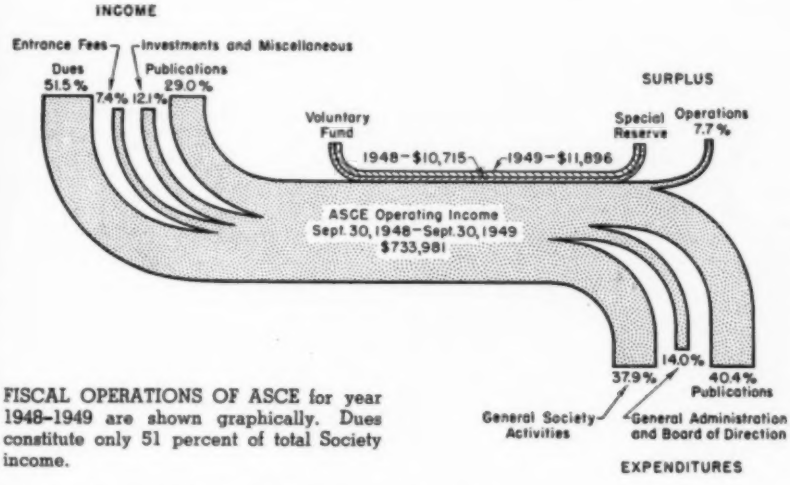
In regard to the comparative cost of the benefits as related to the premiums to be charged, any such comparison must be made with the cost of individual policies which the members of the Society might purchase on their own initiative, since the cost of true group coverage for a company's employees is not applicable because members of the Society do not constitute a group in the service of a common employer that could qualify for such group coverage. A cost comparison is difficult, and at best must be a general comparison made on the basis of the underlying rates, because of the varying combinations of benefits offered under individual policies, none of which conforms with the particular combination of benefits under the present proposal.

However, it probably is of first importance to you to have a statement of the savings in cost under the proposal, as compared to the premiums a member of the Society would have to pay for somewhat similar coverage if he bought his own insurance on an individual basis, and we give as our opinion that under the proposed plan there would be at least a 25 percent saving in cost to the members of the Society.

ASCE Official Register for 1950 Will Be Issued in May

The ASCE OFFICIAL Register for 1950, with data as of March 1, will be mailed to all members in May. The 100-page publication will include the revised Code of Ethics; ASCE officers; committees of the Board of Direction and the Technical Divisions; the constitution and bylaws; a directory of Local Sections and Student Chapters and their officers; past Society meetings and officers; medals, prizes, and awards; and the condensed annual report of the Board of Direction for 1949. Lists of members, both alphabetical and geographical, and life members are contained in the Yearbook number of the January PROCEEDINGS, which was recently mailed to every member.

The accompanying graphic presentation of ASCE financial operations for 1949 is preprinted from the condensed annual report in the Official Register. It should be noted that operation of the Society during the year amounted to a per capita cost of $26.32, whereas per capita dues income, based on the average membership for the year, came to $14.85. Copies of the complete annual report of the Board of Direction to the membership, containing a full statement of the Society's fiscal operations for 1949, are available without charge on request to the Executive Secretary, 33 West 39th Street, New York 18, N. Y.



FISCAL OPERATIONS OF ASCE for year 1948–1949 are shown graphically. Dues constitute only 51 percent of total Society income.

EJC Survey Shows Drop in Employment of 1950 Engineering Graduates

ENGINEERING GRADUATES THIS year face a 30 percent drop in employment opportunities from the 1948 level, according to the General Survey Committee of Engineers Joint Council, which recently completed a canvass of representative industrial concerns, government and state agencies, and engineering colleges. Reporting its findings at an EJC meeting held at ASCE headquarters on March 17, the General Survey Committee called attention to the fact that last year's survey (see CIVIL ENGINEERING for June 1949, page 60) did not cover graduates in physical science or the demands from engineering colleges. Information obtained last year concerning the trend of salaries for engineering graduates ten years out of college was not requested in 1950.

A decrease of 28 percent in employment is indicated by 144 industrial organizations reporting, and a decrease of 33 percent by 23 government agencies. The 64 engineering colleges polled concerning teaching and research positions available, report a probable drop of 44 percent from last year's employment figures. Only chemical companies of the large industrial groups do not expect a decline in employment, and a decrease of only 5 percent from 1949 is expected in the chemical engineering field. In civil engineering, as in the other engineering curricula, estimated decreases are of the same general order of about 30 percent. The reporting organizations are currently employing 91,400 engineering graduates.

Physical science graduates also face reduced employment opportunities, according to the EJC survey. Polled organizations currently employing 13,100 such graduates expect a general drop of 16 percent from last year's figures. Although employment of chemists will probably decrease by 14 percent, a 7 percent increase in employment of physicists is predicted. In both general fields, decreases are expected at the bachelor's and master's level, but an increase of 27 percent at the doctorate level is forecast.

Average starting salaries of $255 a month for those with bachelors' degrees are about the same as for last year, with chemical and petroleum companies offering the highest salaries. For graduates with masters' degrees, the average will be about $320 a month, and for those with engineering doctorates $445. In engineering colleges seeking teachers and research workers, however, $390 will be the average starting salary for graduates with doctors' degrees.

The EJC survey calls attention to the fact that though starting salaries for graduates with bachelors' degrees have changed very little since 1949, increased medians at the master's and doctor's levels indicate a higher evaluation of advanced training.

Committee on Hydrology Lists New Reading

THE FOLLOWING REFERENCES are presented as an addition to those published on pages 50 and 51 of the October 1949 issue of CIVIL ENGINEERING. This compendium concludes the work of the ASCE 1949 Committee on Hydrology in reviewing the literature for material considered to offer worth-while advance in knowledge or method. The committee expects that the 1950 review of similar material will be available in the fall.

The following references present the first advice on Runoff and add to those already given on Infiltration and Groundwater Storage.

Runoff References

1. **The World's Water Supply and Australia's Portion of It.** By W. H. R. Nimmo, *Journal of Institute of Engineers*, Australia, Vol. 21, March 1949, pages 29–34. Australia lies athwart the high pressure belt of the southern hemisphere and therefore is one of the driest continents of the Earth. Its average rainfall is only 16.5 in. per year, compared with 26 in. for all land areas of the world and 30 in. for the United States. Annual runoff ranges from 178 in. on the northeast coast to less than 5 in. around dry "Lake" Eyre. Runoff from the continent as a whole (excluding Tasmania) averages only 1.3 in., compared with 9 ¾ in. for all land areas of the world and 9 in. for the United States. Even if runoff is reckoned on the 48 percent of the area of Australia that drains into the ocean it becomes only 2½ in. The total runoff is equivalent to only one-half the discharge of the Mississippi River. The flow of the largest river, the Murray, would be about 12,000,000 acre-ft per year if there were no diversions. This is about ⅓ of the flow of the Colorado River. The potential development of the surface-water resources of the continent is competently interpreted in terms of the most modern views on the hydrologic cycle. The paper shows that because of its special hydrologic conditions, the development of the water resources of Australia cannot follow those of more humid countries. To assure maximum development on a sound basis there is need for a thorough investigation of the water resources by the state authorities.

2. **A Representative Period for a Water-Supply Study.** By Leonard L. Longacre, *Transactions* of A.G.U., Vol. 29, No. 5, October 1948, pages 682–687. Residual Mass Diagram used effectively to compare California runoff records and establish missing sections of important data.

3. **Large Rivers of the United States.** *Geological Survey Circular 44*, U.S.G.S., Washington 25, D.C. A short discussion of large rivers of the United States, with pertinent data regarding 26 of the largest, ranked according to discharge. The length, drainage area, mean discharge, source and mouth are shown for each of the 26 rivers. Included also are the drainage areas of several additional streams of large drainage area but relatively low average flows. This report provides general hydrologic information of authoritative character.

4. **Stream Flow Variability.** By E. W. Lane and Kai Lei. PROCEEDINGS, ASCE, Vol. 75, No. 7, September 1949. The flow-duration curve has long been used in studies of the flow characteristics of streams. This paper suggests that the standard deviation of the logarithm of the stream discharge be used as an index of the variability. This index is a measure of the average slope of the duration curve when plotted on logarithmic probability paper. Indexes are published for 224 gaging stations in the northeastern United States, and the influences of drainage basin characteristics on the variability of flow are discussed. It is concluded that the geology (including soil cover) and the presence of lakes and swamps are the most important factors influencing stream flow variability the greater part of the time. Based on the analysis of the flow duration curves for 224 gaging stations a method is proposed for developing synthetic duration curves.

5. **A Reference Plane of Flood Volumes in the Sacramento-San Joaquin Basin, California.** By John W. Kuhnel, *Transactions* of A.G.U., Vol. 30, No. 1, February 1949, pages 98–115. Runoff data from 148 stream gages, 30 of which had records of more than 30 years, were selected as representative of a wide range of topographic conditions. Using annual runoff, mean elevation, size of the basin, and orientation of the basin as indexes, depth-area curves of "flood to be expected on only rare occasions" were established for the region. Analysis of the plottings develops interesting findings for valley and high mountain areas.

Additional Infiltration References

1. **Commission on Underground Waters—Infiltration.** By G. W. Musgrave. SCS, Washington, D.C., 1948. The author reviews the progress made in the field of infiltration since 1939. Paper presented at International Union of Geodesy and Geophysics, August 18, 1949, Oslo, Norway. Discusses interrelationships and changes occurring in both the fluid and the permeable medium under infiltration of water into the soil. Considerable research has been undertaken on the causes of aggregate formation, relative stability, and destruction of aggregates and the deterioration of permeability and infiltration. Vegetative and organic influences have been studied by investigators. Raindrop impact, earthworm effects, slaking, colloidal swelling, all have been and are under investigation. Some practical applications of the infiltration concept are reported in the field of estimating maximum runoff, better understanding of the runoff process and comparison of land use practices as they affect flood production and water and soil conservation.

2. **Runoff from Pastures in Relation to Grazing Intensity and Soil Compaction.** By R. B. Alderfer and R. R. Robinson. *Journal* of Amer. Soc. Agron., Vol. 39 (11), No. 1947, pages 948–958. Runoff losses during the summer from various sites in pastures and grasslands on Hagerstown and Morrison soils were determined by means of a type F rainfall simulator. Water losses were supplemented by measurements of vegetative cover, percentage slope, volume weight, capillary and non-capillary porosity, organic matter content, pH, and the mechanical analysis of the soil. Findings relative to heavily grazed pastures and ungrazed area give useful data.

3. **The Infiltration Approach to the Calculation of Surface Runoff.** By Howard L. Cook. *Transactions* of A.G.U., Vol. 27, No. V, October 1946, pages 726–743. Discussions, Koelzer, Foster, and Smith, pages 744–747. Discussions, Langbein, Lewis, and Cook, Vol. 28, No. VI, December 1947, pages 948–950. The paper presents a detailed qualitative analysis of infiltration phenomena, and methods of deriving infiltration curves from rainfall-runoff records for small, homogeneous drainage areas, larger areas, and artificial rainfall and consequent runoff for experimental plots. The necessity is stressed for separating groundwater and subsurface flow from the total runoff. Various indexes are developed for use in analysis and design. Methods are outlined for computing surface runoff by infiltration curves and by infiltration indexes.

4. **Surface-Runoff and Infiltration.** By Hans Albert Einstein. *Transactions* of A.G.U., Vol. 26, No. III, December 1945, pages 431–434. This paper deals with infiltration in and adjacent to alluvial river beds, with especial attention to debris cones at the base of mountains in semi-arid country.

5. **Rainfall and Runoff.** By Edgar E. Foster. The Macmillan Co., New York, 1948, 487 pages. This book is a summary of data and information on subject of rainfall and runoff, with especial attention given to statistical analysis. Infiltration is discussed briefly with references to the works of a

number of investigators. Groundwater and permeability are discussed with greater detail.

6. **Comparison of Lysimeter Runoff, Infiltration, and Percolation to Stream Flow.** By L. L. Harold. *Transactions* of A.G.U., Vol. 28, No. 3, June 1947, pages 438–442. The phenomenon of stream runoff fed largely by subsurface flow has been analyzed with lysimeter records and rainfall-runoff records for 122 acres of mixed-culture agricultural land in the Coshocton, Ohio, experimental area. A record in March 1945, when soil moisture was high, indicated most of the runoff to be subsurface; one in September 1945, following a dry summer, showed the source of stream flow to be predominantly from surface flow.

7. **Time-Condensation in Hydrograph-Analysis.** By H. N. Holtan, with discussion by Sherman, Free, Browning, and Musgrave. *Transactions* of A.G.U., Vol. 26, No. III, December 1945, pages 407–413. Use is made of a technique of condensing the time scale (abscissa) of a rainfall-runoff record in which the ordinates of rainfall, runoff, retention, detention, etc. are measured in inches depth. The rainfall is replotted as a straight line; the entire curve of mass-runoff is condensed to the same condensed time-scale as the rainfall. The purpose of the analysis is to derive the infiltration curve of the drainage area. The analysis is complicated by pocket storage, quick-return subsurface flow, and the recovery of infiltration capacity during lulls in the storm.

8. **Report of the Committee on Infiltration, 1944-1945.** By G. W. Musgrave, chairman. *Transactions* of A.G.U., Vol. 27, No. I, February 1946, pages 125–138. The report consists mainly of a paper discussing the variables in infiltration and exploring the possibility of developing equations expressing the measurement of various phenomena involved in infiltration of water into soil and of its movements within the soil body.

9. **Factors in Permeability Changes of Soils and Inert Granular Material.** By A. F. Pillsbury and D. Appleman. *Soil Science*, Vol. 59, No. 2, 1945, pages 115–123. The authors find that when water begins to percolate through a previously unsaturated soil, it traps air which it cannot displace. This trapped air was removed only by solution in the water percolating through the soil. In the field, it appears that such air would not be dissolved appreciably by normal rainfall or irrigation. Exceptions would be water-spreading basins, where water completely covers the surface for considerable periods, and the conditions occurring below the surface of groundwater tables.

Additional Groundwater Storage References

1. **Methods Used in Estimating the Groundwater Supply in the Wichita, Kansas Well-Field Area.** By Charles C. Williams and Stanley W. Lohman. *Transactions* of A.G.U., Vol. 28, 1947, page 120. Paper presents methods used in estimating groundwater supplies of an area in south-central Kansas. Data available for study are summarized and several hydrologic factors are evaluated. Methods used in estimating recharge, quantity of water withdrawn from storage, and water available for pumping are described with results.

2. **Apparent Changes in Water Storage During Floods at Peoria, Illinois.** By Max Suter. *Transactions* of A.G.U., Vol. 28, 1947, page 425. The effect of three Illinois River floods on water levels and apparent storage of groundwater near Peoria discussed. Quantity of water in storage and apparent changes in storage calculated. Concluded that rise is probably chiefly a pressure effect due to loading by flood waters.

3. **Value of the Electrical Log for Estimating Groundwater Supplies and the Quality of the Groundwater.** By B. A. Barnes and Penn Livingston. *Transactions* of A.G.U., Vol. 28, 1947, page 903. This paper gives a brief summary of the value of the electric log for estimating presence and quality of groundwater supplies, from studies made in Texas. Aside from its great value in correlation, the electric log gives qualitative information on permeability and water quality. Examples shown and described.

4. **The Induced Infiltration of River Water to Wells.** By Raphael G. Kasmann. *Transactions* of A.G.U., Vol. 29, 1948, page 85. Two methods are described for determining whether surface water infiltration to an adjacent aquifer can be induced by pumping from wells. Both methods depend on interpretation of water-level contour maps. A method for determining the effective distance to the line of recharge also is given.

5. **Groundwater Records in River-Flow Forecasting.** By Carroll F. Merriam. *Transactions* of A.G.U., Vol. 29, 1948, page 384. Assured flow of Susquehanna River has been forecast successfully by study of the characteristics of two elements in the recession curve. Weekly well readings have been reduced to a common index figure representative of groundwater storage, which is utilized to estimate groundwater discharge. Maximum rate of decline of direct runoff component also studied. Predictions of total assured flow made by combining two parts; results of 7- and 14-day predictions for two years graphed.

6. **Artificial Recharge of Groundwater by the City of Bountiful, Utah.** By H. E. Thomas. *Transactions* of A.G.U., Vol. 30, 1949, page 539. Discusses attempts of city of Bountiful, Utah, to recharge confined aquifers of alluvial sand and gravel. Due to unusual geologic conditions, recharge entered shoreline deposits to east. Illustrates need for careful investigation of geologic and hydrologic conditions prior to and continuing into recharge operations.

Engineering Foundation Reports Research Advances

SPONSORSHIP AND GRANTS of $42,500 by Engineering Foundation to twelve fundamental research projects and to two projects in advancing the engineering profession stimulated contributions of $642,800 to these projects from industry and universities during 1949, according to the Foundation's annual report.

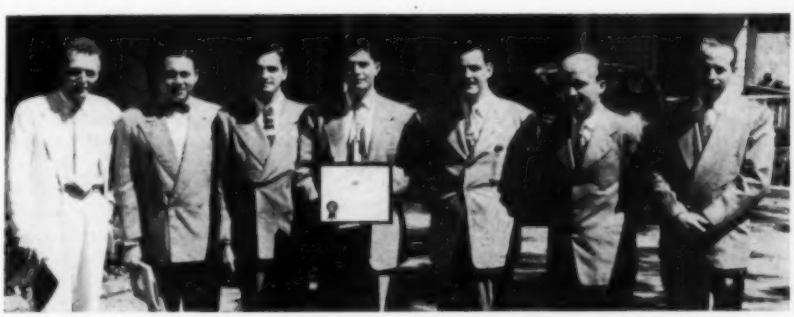
Notable among current Foundation projects are three councils (on riveted and bolted structural joints, on the properties of columns, and on the characteristics of reinforced concrete) sponsored by ASCE. The oldest of the three, on riveted and bolted joints, has six research projects under way, and the results should soon be of value in the design of new railway and highway bridges, and in strengthening older bridges now subject to steadily increasing traffic loads and speeds. One important conclusion already available, according to the report, is that a bolted joint has considerably higher resistance to failure by fatigue than a similar joint fabricated with either hot- or cold-driven rivets.

In summarizing Foundation projects for advancing the profession, the report cites ECPD achievements in accrediting engineering curricula and its projected survey of South American universities with the objective of recommending accrediting standards there. The report also mentions ECPD tests for determining professional aptitudes.

Radio Program Honors ASCE Charter Member

THEODORE JUDAH, CHARTER member of the Society and a pioneer in railroad development, was the subject of a recent Cavalcade of America radio program entitled "Crazy Judah." The half-hour program, sponsored by the DuPont Co. and broadcast by NBC with Douglas Fairbanks in the title role, honored Mr. Judah for his part in building the first transcontinental railroad. In an epilogue, bridging the period between Judah's death in 1863 and 1931 when ASCE dedicated the Southern Pacific monument at Sacramento to him, the broadcast referred to him as a "charter member of the Society" and a "great, good man, one of the pioneers of American engineering history."

The inscription from the Judah Memorial, presented as a conclusion to the program, reads: "That the West may remember Theodore Judah—Pioneer, civil engineer, and tireless advocate of the first transcontinental railroad in America—this monument is erected by the men and women of the Southern Pacific Company, who, in 1930, are carrying on the work he started in 1860. Theodore Judah died November 2, 1863. His railroad was built past the site of this monument, over the lofty Sierras, along the line of Judah's survey—to a junction with the Union Pacific at Promontory, Utah, where on May 10, 1869, the last spike was driven home."



OFFICERS OF RECENTLY INAUGURATED STUDENT CHAPTER at University of Puerto Rico (see "Civil Engineering" for March, page 60) are, left to right, Prof. Franklin O. Rose, Faculty Adviser; Angel M. Rivas, treasurer; Luis F. Santiago Echegaray, assistant treasurer; Jorge A. Juncos, president; Sivan F. Van Derdys, secretary; Rafael D. Chervoni, vice-president; and Mr. Ramon Gelabert, Contact Member.

PROCEEDINGS PAPERS
AVAILABLE AS SEPARATES

THE FOLLOWING PAPERS, to be printed as Separates, are now subject to advance orders, based on the summaries here given. Discussion of these papers will be received as in the past. A summary of each paper will appear in three consecutive issues of CIVIL ENGINEERING, and papers will be mailed soon after returns give an indication of the number to be printed. Abstracts of other papers will be added every month to the list of Separates available. Information concerning distribution to members is noted on the mail order coupon (p. 89).

1. Improvements at the Back River Sewage Works, Baltimore, Md., by C. E. Keefer, M. ASCE.

2. Public Utility Condemnation Cases in the State of Washington by Henry L. Gray, M. ASCE.

3. Treatment of Foundations of Large Dams by Grouting Methods by A. W. Simonds, M. ASCE, Fred H. Lippold, M. ASCE, and R. E. Keim, Assoc. M. ASCE.

4. Capillary Phenomena in Cohesionless Soils by T. William Lambe, Jun. ASCE.

5. Elastic Restraint Equations for Semi-Rigid Connections by J. E. Lothers, M. ASCE.

6. Slope Deflection Equations for Curved Members by Keith T. Fowler, Jun. ASCE. Complex structural frameworks, particularly when under multiple loading conditions, are shown susceptible to simple solutions with few unknowns. "Curved members" include those with a variable moment of inertia. The theory is based on the neutral point concept of the column analogy, and discusses the values added to or subtracted from the fixed-end reactions by changes in the relative positive of the supports. No restriction is placed on the applied loads or joint deflections (including rotations) as long as they lie in the plane of the structure. Three examples, with detailed calculations, illustrate the method. (Available April 1.)

7. The Geochemistry of Earthwork by Hyde Forbes, M. ASCE. Geologic and chemical processes account for the kinds and quantities of mineral substances found in earth that has been "worked" in the presence of air and water—for example, those set up in the compaction of earth structures and over earth surfaces in excavation. The most obvious and readily determined physical change is shown to be the production of fine particles and colloidal material from the constituent crystalloid minerals with excavation and working The resulting mineralogical change is apparent through the comparison of the specific gravity of the mineral particles before and after being worked. (Available April 1.)

8. Floating Tunnel for Long Water Crossings by Charles E. Andrew, M. ASCE. A novel and unusual type of floating tube is proposed, to cross Puget Sound from Seattle to the west shore, approximately 14,800 ft. Water depths of between 750 and 800 ft for 10,000 ft preclude any structure on piers. At the center a 50-ft draft clearance is provided between ventilating towers 3,500 ft apart. This four-lane tunnel, involving a self-liquidating bond issue of $60,000,000, will reduce the present ferry cost to less than one-half. An alternate proposal involves floating and suspension bridges at an adjacent site. (Available April 1.)

9. Atchafalaya River Diversion and Its Effect on the Mississippi River by Leo M. Odom, M. ASCE. These new data and concepts concern one of the greatest river problems of all time. In a century the Atchafalaya has grown from a small bayou to a river discharging 640,000 cfs (1945 flood), to the alarm of many able engineers. More recently its increase has been aided by the Mississippi River Commission as part of the over-all flood control project. Many contentions of opponents to its growth have been unanswered, but this paper apparently refutes the claim that increase in the diversion would cause the Mississippi to lose capacity below that point. (Available April 1.)

10. Pollution Abatement Policy by Thomas R. Camp, M. ASCE. Since the objective of pollution abatement is to reclaim watercourse for appropriate uses, control agencies should aim toward maintenance of adequate water quality at least cost rather than wholesale construction of treatment works. They should permit selection of wastes to be treated for greatest overall economy and provide for assessment of costs in proportion to the amount of wastes produced, whether treated or not. Agencies should establish limiting pollution loads allowable at each point of pollution and should re-allocate loads when other riparian owners wish to produce liquid wastes. (Available April 1.)

11. Long-Term Storage Capacity of Reservoirs by H. E. Hurst. To enable the Nile to be fully used for irrigation in Egypt and the Sudan, large storage reservoirs in Lake Victoria and Lake Albert will store water over long periods, equalizing the flow of the White Nile even through low years. For determining the storage required to guarantee a given draft, long-term records of many phenomena have been analyzed, including rainfall, river discharges, the annual growth of the big California trees, and the annual deposits of mud in lakes. The analysis brings out the difference between natural phenomena and chance events. (Available May 1.)

12. Influence Charts for Concrete Pavements by Gerald Pickett and Gordon K. Ray, Jun. ASCE. Using special charts it is easy to obtain theoretical deflections and stresses within a pavement slab regardless of the distribution of loading. For example, for an airplane landing gear with twin wheels in tandem, the imprint of the tires is drawn on transparent paper to a scale that depends on the slab and its supporting subgrade. The drawing is then placed on the appropriate chart in the proper position and data are taken directly from the area covered. The basis for the charts is given. (Available May 1.)

13. Reinforced Concrete Skewed Rigid-Frame and Arch Bridges by Maurice Barron, M. ASCE. This original presentation permits analysis and design that indicate the effect of skew on a barrel arch or rigid frame. Thus the skew problem resolves into a sort of secondary stress analysis, the ordinary stresses for a rectangular structure being considered primary. Then in the final design steel reinforcement and unit stresses are considered as functions of the similar rectangular elements. Equations and transformations are derived for all applied loads and for volume changes; and a test evaluates the importance of the skew effects. (Available May 1.)

14. Mathematical Analysis of an Aerial Survey by Lo-Ho. In the comparatively brief time since geodetic engineers and surveyors have taken to the air for blanket solutions of their problems, the explorers in this field have become identified in two categories—those who like to reduce their "notes" by instruments (stereometric topographic mapping) and those who place a greater reliance and emphasis on analytical analysis (analytical photogrammetry). Professor Lo-Ho stakes his claim in the latter field, and offers for discussion a procedure for the application of least squares to the successive correction of observations resulting from his system of aerial triangulation. A special feature of the paper is the author's statement of condition equations using the direction-cosine principles of space geometry. (Available May 1.)

15. Computation of Equitable Charges for Treatment of Municipal Sewage by Ellis E. Bankson, M. ASCE. It is hoped that, by discussion of this paper, a sound basis may be established for adopting rate schedules for sewage service. Such a schedule should include the special and unique cost features of ground-water infiltration (which are about equal to the cost of domestic flow, at nearly 30 gal per capita per day). Provision for daily peak flow produces a spread of equitable charges, in this case, from 18 cents per thousand gal to 7 cents per thousand gal. Modern needs of high specialization take into account a difference between frugal and unrestricted home use, as well as the difference between the use recorded by individual water meters and a master meter for a housing project. (Available May 1.)

D-VII Discussion of Paper, **Deflection of Plywood Beams Due to Moisture Content Change,** by W. E. Wilson and Laurence G. Olson. The original paper, published in the April 1949 PROCEEDINGS (p. 429), explores the reasons for the deformation of long floor panels of plywood box girder construction. M. W. Jackson, assistant professor of civil engineering at Georgia Institute of Technology, has discussed the internal stresses in a piece of plywood subject to variations in moisture content, and the authors have closed the discussion with a brief reply to Professor Jackson. These discussions only are included in Separate D-VII, to supplement the main paper. (Available May 1.)

16. Pavement Bearing Capacity Computed by Theory of Layered Systems by Guthlac

Wilson, M. ASCE, and G. M. J. Williams, Jun. ASCE. A new method, based on the theory of elastic layered systems, for estimating the bearing capacity of road and airfield pavements, is described in this paper. It is applicable to both rigid and flexible pavements. All the important properties of the materials comprising the pavement and subgrade can be taken into account including pre-existing stresses in the subgrade. Charts are obtained from which the required pavement thickness can be read directly, if the loading and the physical properties of the subgrade and pavement are known. The more commonly used methods for computing pavement thicknesses are discussed and compared, particularly in so far as they permit consideration of the various factors entering the problem. (Available June 1.)

17. Origin and Significance of Openwork Gravel by Allen S. Cary, Assoc. M. ASCE. Stream deposits of "openwork" pebbles and boulders without interstitial sand were responsible for leakage which led to the failure of the Cedar Reservoir in Washington. The very common occurrence of "openwork" gravel in the Pacific Northwest led to a study of its origin, distribution, and effect on the design of dams, levees, and other works involving water. The right abutment of the Chief Joseph Dam on the Columbia River in Washington consists of a 100-ft-thick bed of extremely pervious openwork gravel resting on bedrock 20 ft below river level and overlain by a very dense impervious bed of glacial till hardpan. The high permeability and the poor grading of the gravel pose a difficult problem of unwatering the right abutment during construction and of controlling seepage after completion. (Available June 1.)

18. Successive Approximations for Beams on an Elastic Foundation by E. P. Popov, Assoc. M. ASCE. A general method for solving problems of beams on an elastic foundation is given in this paper. Complex problems with variable moment of inertia of the beam and variable foundation modulus can be solved with relative ease by the proposed method. The procedures used are simple and are based on the well known moment-area or conjugate beam method of analysis. The difficult mathematics that occur in the usual solution of such problems are completely avoided. The proposed method should find practical applications in structural and foundation work. Even junior members of the profession can master the method quickly. Detailed examples solved in the paper illustrate the method. (Available June 1.)

19. Flood-Control Operation of Tennessee Valley Authority Reservoirs by Edward J. Rutter, M. ASCE. After engineering projects are completed, it is always of great interest to know whether or not they will function as planned. In the case of flood-storage reservoirs, it may be many years before a flood occurs which is large enough to test the planned operations. Recent floods in 1946, 1947, and 1948 provided such a test for the large system of reservoirs constructed by the Tennessee Valley Authority. Actual operations of the tributary and main Tennessee River reservoirs during those floods are described, and comparisons of actual flows with computed natural flows are shown in tabulations of crests and by

(*Continued on page 88*)

FROM THE NATION'S *Capital*

JOSEPH H. EHLERS, M. ASCE
Field Representative, ASCE

DEVELOPMENTS OF THE last month include the attainment of several extremely important Society objectives in governmental affairs.

National Science Foundation Bill Passes

First, the House of Representatives passed the National Science Foundation legislation (H.R. 4846). It will be recalled that when this bill was first introduced it provided for research in many fields but did not include engineering. An EJC Panel, set up under the able chairmanship of Boris Bakhmeteff, Hon. M. ASCE, succeeded in having research in engineering added to the objectives of the proposed legislation. After a long struggle in which the EJC Panel made several appearances to present testimony, the legislation was approved by the House Committee. Although the bill was held up in the Rules Committee, the Chairman of the Committee on Interstate and Foreign Commerce succeeded in bringing it before the House under the 21-day discharge rule, and it passed by a large majority. The measure is designed to develop a national policy for the promotion of fundamental research and education in the sciences, through grants of scholarships and graduate fellowships and the interchange of scientific information. Prior to passage by the House, several amendments providing for security clearances were added. A limitation of $15,000,000 per year expenditure was added by way of amendment. The measure now goes to the Senate, which has already passed a companion bill, and presidential signature is fairly certain.

Second, in the proposed Army Organization Bill (H.R. 5794) amendments designed to protect the professional status of engineers in military engineering work were inserted. (See October 1949 CIVIL ENGINEERING, page 33.) This bill originally placed all authority in the hands of the Secretary of the Army, doing away with statutory powers of the Corps of Engineers and other basically engineering services. The EJC Panel, under chairmanship of Carlton S. Proctor, M. ASCE, negotiated successfully with the Army concerning two amendments which would require professional qualifications for those engaging in military engineering work. The Army accepted these amendments as its own and presented them to the Committee at the hearings in March. The amendments are as follows:

306(*f*) "Under regulations prescribed by the Secretary of the Army officers of the Army assigned to technical, scientific, or other professional duties shall possess qualifications suitable for the performance of those duties; and, when the duties involve the performance of professional work, the same as or similar to that usually performed in civil life by members of a learned profession, such as engineering, law, medicine, or theology, they shall, unless the exigencies of the situation prevent, possess, by education, training, or experience, qualifications equal or similar to those usually required of members of that profession."

404(*e*) "Nothing in this Act shall be construed as reducing or eliminating the professional qualifications required by existing laws or regulations of officers of the several different branches of the Army."

Engineering Advisory Board for CSC

Third, the U.S. Civil Service Commission has accepted our proposal to establish an Engineering Advisory Board within the CSC. This action marks the culmination of a decade of effort which first gained impetus by the publication on 1939 of reports on the Civil Service System by a Presidential Commission on which engineers were represented by Gano Dunn, Hon. M. ASCE. The idea was slow in crystallizing. Intensive efforts have been directed toward the accomplishment of this objective during the past six months, and what seemed to be formidable barriers have finally been overcome. The EJC Committee on Engineers in Civil Service, which was under chairmanship of the ASCE member, handled the matter.

Of course these three accomplishments are in reality only challenges to further efforts to make the resulting National Science Foundation and the Civil Service Engineering Advisory Board produce results in providing improved engineering research and services and to see that the provisions inserted in the Army Organization Bill are finally enacted into law.

EJC to Advise Water Policy Commission

The National Water Policy study previously mentioned in CIVIL ENGINEERING (March issue, page 55) will be referred to so often in the near future and is of such importance that a brief survey of the situation is given here.

In December 1949, an Engineers Joint Council Panel that had been studying possible approaches to the problem made its report recommending steps to be taken to secure the establishment of a

commission which would be of top caliber, completely impartial, and adequately financed. At the request of the EJC Panel, the Field Representative communicated this information to the White House, expressing our interest in the subject and endeavoring to bring EJC closer to the rapidly unfolding governmental developments in this field.

The matter had been under close study in the Budget Bureau, and a few days later the President appointed a temporary National Water Policy Commission (February issue, page 72) to report December 1, 1950, on overall policies in the field. EJC was invited to present any reports it desired to the Commission in an advisory capacity. A group of top level experts in domestic water supply, irrigation, power, water transportation and recreation under the direction of Dr. Abel Wolman, M. ASCE, chairman of the EJC Coordinating Committee, will direct preparation of these EJC reports.

The President's Commission is working largely with personnel assigned by government departments but will employ a few prominent economists and others from outside the Government.

Truman Transmits Government Reorganization Plans to Congress

A group of 21 government reorganization plans were transmitted to the Congress on March 13. They become effective in 60 days except in so far as any of them may be acted on adversely by Congress. Plan No. 17 is of special interest to the Society. Under it the Advance Planning work of General Services Administration (the former FWA) would be transferred to the Housing and Home Finance Agency. Plans 1–16 and 18–21 follow Hoover Commission recommendations; No. 17 is generally contrary to those recommendations. Community facilities and public buildings work were to be placed in the Interior Department under the Hoover plan, in part because they concerned the planning of construction in connection with employment stabilization.

Washington, D.C.
March 22, 1950

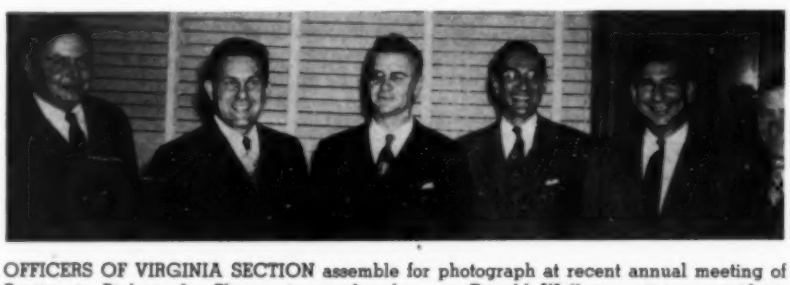
TOTAL MEMBERSHIP AS OF MARCH 9, 1950

Members	7,534
Associate Members	9,707
Corporate Members	17,241
Honorary Members	39
Juniors	10,976
Affiliates	73
Fellows	1
Total	28,330
(March 9, 1949	25,230)

Manuscript Available for Reference in E. S. Library

TO THE LIST of worth-while papers filed in the Engineering Societies Library, where they are available for reference, has been added a 550-page illustrated manuscript, "Fundamental Principles of Elastic Theory as Applied to Solid Elastic Systems," by Egidio O. Di Genova, M. ASCE, doctor in civil engineering (Italy).

This extensive work provides an introduction to the fundamental concepts of elastic theory and a text for the engineer in analyzing the action of forces upon elastic systems. Separate chapters cover basic principles, theory and practice of elasticity, least work, influence lines, ellipse of elasticity, coplanar elastic systems, elastic arches, elastic frames, and similar topics. The treatise is intended for engineers and others desiring to comprehend the basic principles underlying practical manuals.



OFFICERS OF VIRGINIA SECTION assemble for photograph at recent annual meeting of Section in Richmond. Shown, in usual order, are Donald Wallace, retiring president; Sterry Mahaffey, president for 1950; W. C. Roberts, second vice-president; John Roberts, third vice-president; Stanley Navas, secretary-treasurer; and Stuart Loughborough, assistant secretary-treasurer.

VENEZUELAN SECTION, which was organized two years ago by ASCE members living in and near Caracas, reports that its activities are in full swing. Photographed at its recent annual dinner meeting at Hotel Avila in Caracas are, left to right, Miss Mae Barrett; Edmundo Curiel, secretary; Mrs. Gabriel Disario; Enrique J. Aguerrevere, speaker of evening; Francisco J. Sucre, president; Mrs. Enrique Aguerrevere; Gabriel Disario, past-president; Mrs. Edmundo Curiel; and Eugene V. Barrett, vice-president.

Coming Local Section Events

Alabama—Joint meeting with the Student Chapters of the University of Alabama and Alabama Technological Institute, on the Institute's campus, Auburn, Ala., April 14, at 10 a.m.

Arizona—Joint meeting with University of Arizona Student Chapter, at Tucson, April 21.

Buffalo—Luncheon meeting at the Buffalo Athletic Club, Buffalo, April 18, at 12:15 p.m.

Cleveland—Dinner meeting at the Cleveland Engineering Society, Cleveland, April 21; dinner at 6:30 p.m. and meeting at 8 p.m.

Central Ohio—Dinner meeting at the Chittenden Hotel, Columbus, April 20, at 6:15 p.m.

Colorado—Dinner meeting the second Monday of every month at 6:30 p.m.; technical meeting at 8 p.m. Section luncheons every Wednesday at Daniels & Fishers Department Store at 12 noon. The Soil Mechanics and Foundations, Hydraulics, Structural, and Irrigation Divisions of the Section meet monthly on the first Monday, the first Tuesday, the third Thursday, and the fourth Monday, respectively.

District of Columbia—Meeting in the Cosmos Club Auditorium, Washington, D.C., April 11, at 8 p.m.

Duluth—Meeting in the Kitchi Gammi Club, Duluth, April 17, at 12:15 p.m.

Indiana—Joint meeting with the Juniors at the Old Trail Inn; reception at 5:30 p.m. and dinner at 6:30 p.m.

Kansas—Meeting in Lawrence on April 21.

Kansas City—Meeting in Kansas City on April 18.

Los Angeles—Dinner meeting at Alexandria Hotel, April 12. Junior Forum meeting on April 12. Seminar on writing specifications for mechanical equipment will be held at the California Institute of Technology, April 19.

Maryland—Joint meeting with local Student Chapters in the Engineers Club of Baltimore, Baltimore, April 12; dinner at 7 p.m. and meeting at 8 p.m.

Metropolitan—Meeting in the Engineering Societies Building, New York City, April 19, at 8 p.m.

Northeastern—Joint meeting with the Boston Society of Civil Engineers at Northeastern University, Boston, Mass., April 17, at 6 p.m.

Philadelphia—Meeting in the Engineers' Club, Philadelphia, April 13, at 7:30 p.m.; preceded by dinner at 6 p.m.

Pittsburgh—Dinner meeting of Junior Branch at Downtown Y.M.C.A., April 17, at 6:30 p.m. Inspection tour of the new teaching facilities at Carnegie Institute of Technology, under auspices of Section, on April 25, at 8 p.m.

Sacramento—Regular luncheon meetings every Tuesday at the Elks Club, Sacramento, at 12:30 p.m.

St. Louis—Joint dinner meeting with the Washington University Student Chapter on the university campus, April 24, at 6:15 p.m.

San Francisco—Weekly luncheons every Wednesday at the Engineers Club of San Francisco.

Wisconsin—Ladies' night meeting at the Engineering Society Building, Milwaukee, April 27.

Scheduled ASCE Meetings

SPRING MEETING

Los Angeles, Calif., April 26–29
(Board of Direction meets April 24–25)

ANNUAL CONVENTION

Toronto, Canada, July 12–14
(Board of Direction meets July 10–11)

FALL MEETING

Chicago, Ill., October 11–13
(Board of Direction meets October 9–10)

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Buffalo	Feb. 21	...	ASCE Director Otto Holden gave a speech entitled, "The Ottawa River and the Des Joachims Development."
Central Ohio	Feb. 16	74	Guy Elbin, Franklin County (Ohio) engineer, discussed the development of the Sandusky Street project in Columbus.
Cleveland	Feb. 17	100	Prof. George E. Barnes, head of department of civil engineering and engineering mechanics, Case Institute of Technology, described the problem of river control in Argentina.
Colorado	Feb. 13	65	Dinner meeting with William Henninger, planning director of the City and County of Denver, talking on the work of his office.
	Jan. 16	19	H. Carpenter, of Minnesota Power & Light Co., presented a talk on unwatering problems and foundation construction of several developments.
Florida Gainesville Sub-Section	Feb. 23	...	Prof. Charles G. Edson, of the engineering mechanics department at the University of Florida, discussed the design of spillways on the Suwannee River.
Georgia	Feb. 3	45	Harry C. Robert, Jr., of Robert & Co., Associates, Inc., Atlanta, Ga., spoke on design features of Atlanta expressways.
	Mar. 3	45	Luncheon meeting with Gerald E. Stedman, a writer, discussing the engineer's place in modern industry.
Hawaii	Feb. 10	...	John A. Wilson, mayor of Honolulu and George Houghtailing, director and planning engineer, Honolulu City Planning Commission, talked on the proposed Koolau Tunnel.
	Feb. 17	...	Luncheon meeting with Ben F. Rush, manager and chief engineer of the Board of Harbor Commissioners, speaking on present and proposed waterfront improvements for Hawaii.
Indiana	Mar. 9	...	Marshall D. Abrams, managing director, Construction League, Indianapolis, described his impressions of conditions in Japan since the American occupation.
Intermountain	Jan. 20	26	L. G. Haskell, maintenance engineer for Salt Lake Pipeline Co., spoke on oil line transportation.
	Feb. 17	46	Joint meeting with the Student Chapter of the University of Utah, featuring Roy McLease, city engineer of Salt Lake City, Utah, as speaker.
Iowa	Feb. 14	60	Technical meeting with Prof. A. H. Fuller, civil engineering department, Iowa State College, discussing the Skunk River bridge.
Ithaca	Feb. 21	...	Joint meeting with the Cornell University Student Chapter. E. L. Chandler, ASCE Assistant Secretary, spoke on Society affairs.
Kansas	Jan. 13	38	A panel discussion on national defense was conducted with Maj. I. D. S. Kelly, acting as moderator.
Kansas City	Feb. 21	...	Dinner honoring President Ernest E. Howard. Robert P. Woods, representing the Kansas City Section, presented Mr. Howard with a plaque as a tribute to his achievements.
Kentucky	Jan. 27	107	Joint meeting with the Kentucky Society of Professional Engineers. Television was discussed by Dr. H. Alex Romanowitz, professor of electrical engineering at the University of Kentucky.
Los Angeles	Feb. 8	122	A symposium on planning and design of schools for Los Angeles County; C. C. Carpenter, assistant superintendent of schools; Harry W. Bolin, principal structural engineer, California State Department of Public Works; and Ralph C. Flewelling, architect.
	Feb. 8	60	Junior Forum meeting.
Maryland	Feb. 8	120	Dinner meeting. Capt. H. W. Hemple, chief of the Division of Geodesy of the U. S. Coast & Geodetic Survey, described trends in surveying and mapping.
Metropolitan	Mar. 15	250	Technical meeting. Speakers included John F. Willis, engineer of bridges for the Connecticut State Highway Department, on welding design and practice for highway bridges; and C. L. Kreidler, chief structural engineer for the Lehigh Structural Steel Co., on shop practice used in welded bridge fabrication.

	Mar. 8	...	Junior Branch meeting. A symposium on what is being done to provide low-cost housing was presented by C. A. Monroe, chief engineer, Levitt & Sons; Irwin Clevan, architect for Stuyvesant Town and Peter Cooper Village; and John A. Kervick, director of New York office of Public Housing Administration.
Mid-Missouri	Mar. 9	96	Buffet dinner meeting with President Ernest E. Howard discussing the restoration of the White House.
Mid-South			
Vicksburg Branch	Feb. 6	...	Business meeting.
Jackson Branch	Feb. 24	24	Business meeting. Clyde V. Maxwell, Jr., reported on activities of the public affairs committee, and the problem of securing a new east-west traffic artery across the main line of the Illinois Central Railroad. Murray Smith, assistant meteorologist of the Jackson Station of the U.S. Weather Bureau, spoke on weather forecasting.
Montana	Jan. 13	21	Business meeting with election of officers.
Northwestern	Feb. 6	58	Dinner meeting. R. W. Randall, structural engineer for the Portland Cement Association, presented a talk and film on portland cement.
Philadelphia	Feb. 14	...	Dinner meeting with George L. Freeman, consulting engineer of New York City, discussing the diverse problems handled by a foundation engineer.
Pittsburgh	Feb. 28	90	Col. C. P. Hardy, of the Corps of Engineers, at Pittsburgh, gave an illustrated talk on his experiences in Europe.
Providence	Jan. 24	135	Joint meeting with the Rhode Island Society of Professional Engineers. Speakers included Philip S. Mancini, director of public works for the State of Rhode Island; Frank J. Malley, executive director, Providence City Planning Commission; and Fenton G. Keyes, project manager, Charles A. Maguire & Associates, Providence.
	Feb. 9	75	Maurice A. Reidy, consulting structural engineer of Boston, Mass., talked on the new Jordan Marsh store.
Sacramento	Jan. 3	56	Luncheon meeting with W. R. Creighton, chief of the Division of Narcotic Enforcement, State of California, speaking.
	Jan. 24	80	Presentation of Daniel W. Mead Junior Prize to Sidney L. McFarland. Franklin H. Roberts, local attorney, interpreted portions of the Hoover report.
	Jan. 31	66	Development of the Sacramento-Yolo Port District was described by Dain J. Domich.
St. Louis	Feb. 27	90	A report on the Society's annual meeting was given by Vice-President Robert B. Brooks. George F. Hellmuth, architect with City of St. Louis, discussed housing for blighted areas in St. Louis.
San Diego	Feb. 28	43	Dinner meeting. Four ten-minute papers were presented by members of the Student Chapter at San Diego College.
San Francisco	Feb. 7	83	Meeting of the Junior Forum, featuring student paper competition.
	Feb. 21	390	George H. Atkinson, president, Guy F. Atkinson Co., San Francisco, spoke on the business side of contracting.
Seattle	Jan. 25	78	Business meeting with discussion of engineering ethics.
Southern Idaho	Feb. 7	49	Election of officers. The Hells Canyon Project was discussed by Francis Hart, Dan Applegate, and Don Campbell, all of the Bureau of Reclamation.
Spokane	Jan. 13	...	Business meeting. Phil Holgren, of city engineer's office, Spokane, Wash., talked on the construction of sewerage systems.
	Feb. 10	...	Frank M. Stocking, right-of-way engineer, Washington State Department of Highways, presented a talk on limited access highway facilities.
Texas			
Fort Worth Branch	Jan. 9	...	Drawing reproductions were discussed by Blan Bell, of the Bell Reproduction Co., Fort Worth, Tex.
Tacoma	Feb. 14	...	Dinner meeting with Harry House, manager of the Pierce County Medical Industrial Bureau, as principal speaker.
Toledo	Jan. 31	39	Dinner meeting with President Ernest E. Howard speaking on Society activities.

STUDENT CHAPTER *Notes*

BROOKLYN POLYTECHNIC INSTITUTE

GRAVING DOCK CONSTRUCTION by the tremie method was the topic of an illustrated talk presented before a recent meeting of the Brooklyn Polytechnic Institute Student Chapter (evening group) by Sherman Glass, a BPI alumnus. An informal discussion on the advantages of membership in the Society was conducted by John Molloy, draftsman-designer for the New York firm of Hardesty & Hanover.

MARQUETTE UNIVERSITY

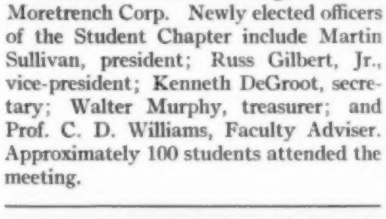
A FILM ON steel fabrication methods comprised the technical program at a recent meeting of the Marquette University Student Chapter.

STANFORD UNIVERSITY

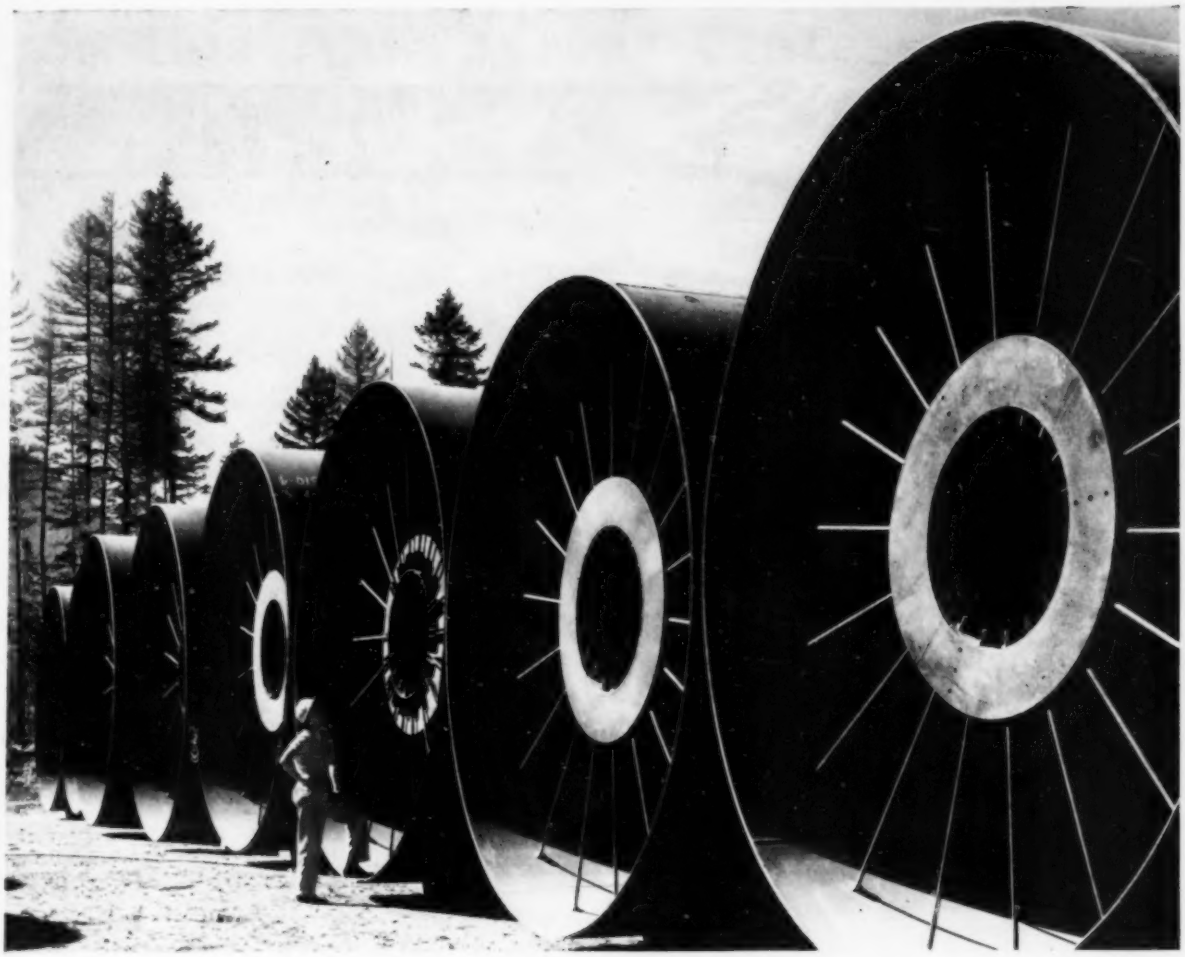
THE HISTORY AND problems involved in construction of the San Francisco sewage system were outlined at a recent meeting of the Stanford University Student Chapter by Ralph Wadsworth, San Francisco city engineer. A field trip to the Stanford Research Institute was described by Bill Warren, Chapter member. Prof. C. H. Oglesby discussed membership in the ASCE.

UNIVERSITY OF FLORIDA

DEWATERING EXCAVATION SITES by the wellpoint system was described at a recent meeting of the University of Florida Student Chapter by G. R. Callender, southeastern district manager of the Moretrench Corp. Newly elected officers of the Student Chapter include Martin Sullivan, president; Russ Gilbert, Jr., vice-president; Kenneth DeGroot, secretary; Walter Murphy, treasurer; and Prof. C. D. Williams, Faculty Adviser. Approximately 100 students attended the meeting.



ASCE PAST-PRESIDENT Franklin Thomas (center), principal speaker at recent meeting of Colorado A. & M. College Student Chapter, is shown here with George Koonsman, Faculty Adviser; R. L. Parshall, Senior Contact Member; and Keith Lautenback and Glen Boodrey, president and secretary of Student Chapter, respectively.



Carry Water to Hungry Horse Turbines

Welded steel penstocks, each 448 ft. long, will carry water to the four 105,000 hp turbines in the power house at the Hungry Horse dam in Northwest Montana. We fabricated the steel for these penstocks in our shops at Salt Lake City and welded it into sections 20 ft. long at the dam site. The above view shows some of the sections in a storage yard ready for delivery to the dam.

Building the 520-ft. high Hungry Horse—world's third highest concrete dam—is a $10,000,000 project. The first 71,250 kilowatt generator is scheduled to go on the line in October, 1952, and all four units will be in operation by November, 1953.

The four penstocks are made of plates ranging from 9/16 in. to 15/16 in. in thickness. They are 13 ft. 6 in. in diam. at the upper end and 11 ft. 9 in. in diam. at the lower end. Constructing them in sections required approximately 8,100 lineal feet of automatic machine welding and 1,300 feet of hand welding. More than 3,600 feet of welded joint was x-rayed.

We are scheduled to start installation of the penstock sections at the dam this spring. This erection work will require an additional 4,000 feet of hand welded seam. The internal "spiders" shown in the above view of the penstock sections are required to hold them round during installation and while concrete is being poured around them. After the penstocks are embedded in concrete, these "spiders" will be removed.

The penstock installation at the Hungry Horse project illustrates how well we are equipped to handle steel plate work for civil engineering projects. We also fabricate and erect plain and differential surge tanks, smokestacks, larger-diameter pipe, flat-bottom reservoirs, elevated water tanks, and similar steel plate structures. Let our nearest office furnish estimates for your next job.

CHICAGO BRIDGE & IRON COMPANY

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Birmingham 1.....1596 N. Fiftieth St.
Boston 10.....1009—201 Devonshire St.
Chicago 4.....2199 McCormick Bldg.
Cleveland 15.....2263 Guildhall Bldg.
Detroit 26.....1541 Lafayette Bldg.
Havana.....402 Abreu Bldg.
Houston 2.....2128 National Standard Bldg.
Los Angeles 17..1556 General Petroleum Bldg.
New York 6.....3395—165 Broadway Bldg.
Philadelphia 3..1652—1700 Walnut St. Bldg.
Salt Lake City 4.....509 W. 17 South St.
San Francisco 11..1284—22 Battery St. Bldg.
Seattle 1.....1309 Henry Bldg.
Tulsa 3.....1647 Hunt Bldg

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

NEWS BRIEFS

Huge Highway Program Urged at ARBA Annual Meeting

A $4,000,000,000 ANNUAL program of highway construction was advocated by Thomas H. MacDonald, Hon. M. ASCE, commissioner of public roads, at the 47th annual meeting of the American Road Builders Association, held in Cincinnati, Ohio, March 6–9. Reviewing the federal-aid program, Mr. MacDonald predicted that, at the present rate of expenditure, $1,750,000,000 in 1949, our highways will be inadequate for traffic demands 15 years from now. "Furthermore," he said, "at the rate maintenance costs are increasing under the necessity of patching up a growing mileage of obsolete, worn-out roads merely to keep them in service, maintenance soon will be consuming the greater part of all highway revenues."

E. R. Needles

Charles M. Upham

In another leading talk, C. E. Brokaw, superintendent of the Highway Maintenance Division of the City of Cincinnati, explained how two-way radio is being utilized by street maintenance crews to fight traffic stoppages caused by street damage or accidental blocking. With the use of radio transmitters, he said, the number of reported street hazards and defects has increased markedly, with attendant reduction of traffic obstructions and hazards caused by utility and pavement failures.

Numerous other aspects of highway, airport, and traffic problems were explored during the four-day program by a distinguished list of speakers, including Representative Will M. Whittington, chairman of the House Committee on Public Works. Calling more and better highways "the most important problem confronting the United States," Mr. Whittington urged an increase in state funds to match federal aid.

In a series of resolutions the ARBA reiterated its position in favor of the contract method for all construction; endorsed the AASHO recommendation for a continued highway program, with the proviso that annual funds recommended be increased to at least $1,000,000,000; and urged universities teaching highway engineering to seek the establishment of more fellowships for postgraduate study in the field.

E. R. Needles, M. ASCE, of the New York and Kansas City consulting firm of Howard, Needles, Tammen & Bergendoff, was renamed president of the organization for a second term. Serving with him as district vice-presidents will be Paul B. Reinhold, Pittsburgh; Charles W. Smith, Pensacola, Fla.; W. A. Roberts, Milwaukee; and T. E. Stanton, M. ASCE, Sacramento, Calif.

During the meeting, which was attended by more than 1,000, President Needles announced the retirement of Charles M. Upham, M. ASCE, engineer-director of the organization since 1926. Mr. Upham will continue to serve ARBA as a consultant, actively assisting in its policies and program, President Needles stated.

Treaty Provides for Increased Niagara Power Output

VASTLY INCREASED DIVERSION of Niagara River waters to give cheap power to both the United States and Canada will be possible under the terms of a recent 50-year treaty signed in Washington by Secretary of State Acheson and the Canadian ambassador to the United States. The treaty, which provides for reserving a minimum flow to protect the Falls and dividing most of the rest between the two countries for power generation, emphasizes the fact that coordinated development of power will now be possible. Before going into effect, the treaty must be ratified by the Senate and the Canadian Parliament.

Replacing a number of outmoded agreements, some of which date back to 1909, the present pact is expected to provide an increase of 7,900,000,000 kwhr for the supply of energy in the heavy industrial areas on both sides of the border. To guarantee the beauty of the Falls the treaty provides for reserving a flow of 100,000 cfs during the summer sightseeing months, which may be reduced to 50,000 cfs from November 1 to April 1. No diversion of water between the Falls and Lake Ontario will be permitted. To produce "an unbroken crestline on the Falls," the treaty states, a system of remedial works in the form of submerged dams will be constructed by the two countries.

Though the pact binds the two countries for 50 years, the State Department calls it a "permanent arrangement" that will put diversion of Niagara River water on a "lasting foundation."

Army to Request Bids on Chief Joseph Dam

INVITATIONS will soon be issued by the Corps of Engineers to bid on the first stage of construction of Chief Joseph Dam, on the Columbia River just east of Bridgeport, Wash., according to Col. E. C. Itschner, M. ASCE, district engineer at Seattle. Principal items of work will include excavation for the right abutment of the dam on the north bank of the Columbia; construction of about 2,000 lin ft of cofferdam; unwatering the cofferdam; and construction of approximately 2,000 lin ft of rolled, impervious upstream blanket.

The contract for the first stage of construction will be awarded as a whole to one bidder, the bid opening date to be about May 2.

Registration Strengthened Through Court Decisions

TWO RECENT COURT decisions upholding professional registration are reported by the National Council of State Boards of Engineering Examiners in the March issue of *The Registration Bulletin*.

Called "precedent making" is a decision handed down by Judge McAllister, of the Court of Common Pleas of Delaware County, Ohio, permanently enjoining the defendant in an action brought by E. L. Luaces, chairman of the Committee of Grievances and Ethics of the Ohio Society of Professional Engineers, "from practicing or offering to practice engineering or surveying within the State of Ohio . . . unless and until the defendant is legally registered and admitted to practice pursuant to the provisions of the Engineers and Surveyors Registration Act, and that the defendant pay the costs herein."

Lloyd A. Chacey, executive secretary of the Ohio Society of Professional Engineers, states that the ruling is "the first clear-cut decision by a court of record in the state establishing the right of a member of the engineering profession to sue in equity to enjoin unlawful practice on the part of an individual not registered and admitted to practice under the provisions of the Engineers and Surveyors Registration Act of Ohio."

The other court decision strengthening the status of professional registration was handed down in a California court, when Justice Lathrop E. Smith, of the San Gabriel Court, ruled that the city engineer of Monterey Park, "who had no formal civil engineering training and claimed none," was practicing engineering illegally. Justice Smith also ruled it illegal for a city to employ a non-registrant as city engineer.

For this New Jersey State Highway

Texaco Asphaltic Concrete paving on State Route 28 (US 22) near Clinton, N. J. Constructed with asphalt mix furnished by Somerset Crushed Stone, Inc., of Bernardsville, N. J.

a pavement that absorbs impact, resists wear, needs no joints

Texaco Asphaltic Concrete

On New Jersey's Route 28, just as on US 81 in Texas, Worcester Turnpike in Massachusetts, New York's Route 17 and Illinois' Route 37, you will find heavy-duty Texaco Asphaltic Concrete paving. These and many other States know from experience on their own highways the ability of this hot-mix, hot-laid type of Asphalt pavement to stand up under the heaviest State Highway traffic. Not only does Texaco Asphaltic Concrete possess rugged endurance, but it has demonstrated conclusively by actual performance its low upkeep cost.

Pave primary highways, important city streets and major airports with Texaco Asphaltic Concrete. Salvage existing pavements serving exceptionally heavy traffic by using them as foundation for a new Asphaltic Concrete wearing surface.

Helpful information on Texaco Asphaltic Concrete and the other plant-mixed types of Asphalt paving is provided in the booklet, "Texaco Asphalt Paving—Plant-mixed Types." You can secure a copy with no obligation by writing our nearest office.

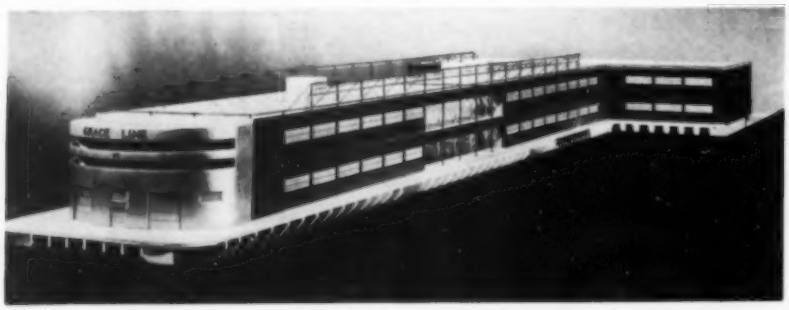
The Texaco Asphaltic Concrete on New Jersey Route 28 was laid in one or two courses over the existing worn concrete and bituminous pavement.

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

Boston 16 Chicago 4 Denver 1 Houston 1 Jacksonville 2 Philadelphia 2 Richmond 19

TEXACO ASPHALT

Fireproof Pier to Be Built on New York Waterfront



UNUSUAL CONSTRUCTION TECHNIQUES are incorporated in pier of novel design that will replace Pier 57 on North River, Manhattan. Designed by E. H. Praeger, M. ASCE, of New York firm of Madigan-Hyland, in cooperation with City Department of Marine and Aviation, pier consists of completely fireproof concrete box-type substructure with modern steel and concrete shed superimposed. Substructure design permits utilization of area beneath main deck for cargo handling and storage. Total load capacity of 97,000 tons represents increase of approximately 110 percent over capacity of old pier. Structure will be built by Department of Marine and Aviation as soon as permit is obtained from War Department.

Army Engineers Begin Work on Florida Water Conservation Project

CONSTRUCTION WAS RECENTLY begun on the $208,000,000 Central and Southern Florida Project for flood control, irrigation, and reclamation, under the direction of the Jacksonville District of the Corps of Engineers. Col. Richard W. Pearson, district engineer, is in general charge of the long-range program, which covers over 15,000 sq miles and will involve construction of a network of levees, canals, and spillways. Local interests, represented by the Central and Southern Florida Flood Control District, with W. Turner Wallis as chief engineer, are contributing 15 percent of construction costs, as well as lands and rights-of-way.

The first phase of the project, which is currently under way, was authorized by Congress in 1948. Estimated cost of this first stage of the work is $70,000,000. Contracts for construction of two sections of levees to protect the Fort Lauderdale area have already been awarded to the Ewell Engineering & Contracting Co. and Reynolds & Smith, Inc., of Lakeland, Fla., and to the Hooper Construction Co., of Miami. Bids for work on a third levee on the West Palm Beach Canal and a 120-ft canal to handle excess floodwaters will be opened the middle of April.

A major feature of the project will be the reclamation of about 650,000 acres of rich agricultural land immediately south of Lake Okeechobee. Levees will be built around the area, which is at present undeveloped and subject to severe annual flooding. The numerous interior canals will be improved, and eight pumping stations will be built to control water levels in the canals. These stations will have from three to six pumps of 480-cfs capacity. Three conservation areas, covering 1,500 sq miles south and east of the acreage to be reclaimed, will be used for storing floodwaters and for replenishing municipal water supplies by raising the groundwater table.

Plans and specifications are now in progress for works to be constructed during 1950 and 1951, though completion of the entire project will probably require more than ten years, depending on Congressional appropriations. Engineering for the project is under the supervision of L. L. Burnet, chief of the Engineering Division of the Jacksonville District. Planning and writing of the Definite Project Report are under the direction of Harold A. Scott, M. ASCE, head of the Flood Control Branch.

Boris A. Bakhmeteff, Hon. M. ASCE, of New York City, and ASCE Director Edmund Friedman, of Miami, have been appointed consultants on the construction of the project.

Improvements in Concrete Hailed at ACI Convention

RECENT ADVANCES IN precast and prestressed concrete construction were described in a symposium on modern concrete techniques highlighting the recent 46th annual convention of the American Concrete Institute in Chicago. Increased use of precast concrete in the construction of buildings, bridges, and other structures was predicted by C. D. Wailes, Assoc. M. ASCE, Los Angeles engineer, in a paper focusing attention on practical applications of precast construction in this country. A new electrical resistance technique for measuring the rate of corrosion of steel reinforcing was explained in a paper on "Corrosion Protection of Thin Precast Concrete Sections," by D. H. Pletta, M. ASCE, E. F. Massie, and H. S. Robins, of Virginia Polytechnic Institute. The basic concepts of prestressed concrete construction were reviewed by Thor Germundsson, Assoc. M. ASCE, structural engineer for the Portland Cement Association, Chicago.

Raymond C. Reese, Assoc. M. ASCE, consulting engineer of Toledo, Ohio, recommended adoption of higher bond stresses for modern deformed reinforcing bars in a review of ACI building code studies during the three-day program. Changes in the code for two-way slab design were suggested by C. P. Siess, Assoc. M. ASCE, and N. M. Newmark, M. ASCE, of the University of Illinois.

Professors Siess and Newmark were awarded the Leonard C. Wason Medal for their paper on "Rational Analysis and Design of Two-Way Concrete Slabs," called "the most meritorious paper of the year." The Alfred E. Lindau Award for outstanding contributions to reinforced concrete design went to Prof. Frank E. Richart, M. ASCE, of the University of Illinois.

Frank H. Jackson was elected new president of the organization, and A. T. Goldbeck, M. ASCE, vice-president.

Drop in Production of Building Materials Noted

PRODUCTION OF CONSTRUCTION materials in 1949 was about 8.5 per cent lower than in 1948, despite the 3 percent increase in new construction put in place during the year, the Department of Commerce reports. The year was characterized, the report states, by the return of all building materials industries to more normal patterns, in comparison with the immediate postwar years when "materials shortages, rising costs, and empty pipelines impeded construction." The decline in production is attributed to the fact that many industries had reached such high levels by the end of 1948 that reduction "in order to permit a more orderly movement of stocks into the market" seemed advisable.

A drop in production costs from the peaks reached late in 1948 is also noted.

Contract Let on Emergency Hudson River Water Supply

WITH THE AWARD of a Board of Water Supply construction contract to the Tuller Construction Co., and A. J. Dillenbeck, both of Red Bank, N.J., work has started on construction of the installations needed to utilize Hudson River water in relieving the current shortage in New York City. The two companies were third low bidder, with a joint bid of $2,684,000, for an electrically operated pumping plant capable of pumping 100 mgd of water from the Hudson into the Delaware Aqueduct against a 600-ft head; a chlorinating plant; buildings suitable for housing both plants; and operation of the plants for a period not in excess of four months following completion.

Details of the project were summarized in the March issue (page 62).

MONOTUBE STEEL PILES save time, cut costs on "hard-to-get-to" job!

YOU'LL get new ideas about the savings and conveniences with Monotubes from the job pictured here.

It's a foundation for an overpass to carry coal cars from a strip mine. Naturally, it has to be strong and rigid—to withstand the multiple-ton weights of loaded coal cars. Construction was wanted quickly.

FAST "DRIVING" RECORD!

First problem was the remoteness of the job—several miles from main access roads. *Because of Monotubes' light weight and easy handling, the contractor was able to move in with a light truck crane and within 4 hours was driving Monotubes!* No special driving equipment was needed for driving the piles on two different batters as well as vertical.

Consider this, too. Rails were to be on a four-degree curve. But the Monotube piles were driven only 7 to 11 feet in undisturbed soil. Unsupported lengths varied from 12 to 15 feet . . . proof again of the stability and resistance to bending of these cast-in-place, tapered steel piles.

Monotubes' many advantages help make savings on foundations for all types of structures. They're inherently strong. They come in lengths, gauges, tapers and diameters for varying soil conditions. There's minimum cut-off waste. They're easily extendible. Jobs started with Monotubes can be *completed* with them.

For information, write The Union Metal Manufacturing Company, Canton 5, Ohio.

Overpass construction at Cadiz, Ohio. Contractor: The W. M. Brode Company, Newcomerstown, Ohio.

UNION METAL

Monotube Foundation Piles

Contractors Warned of Sharp Competition in Building Industry at AGC Convention

DESPITE THE LARGE volume of work coming on the market, indicating that 1950 will be another year of record construction activity, contractors attending the recent annual convention of the Associated General Contractors of America in San Francisco were warned that "what may be the fiercest competition since the middle 1930's appears to be prevailing in the construction industry." Building costs were reported to have stabilized at approximately 10 percent below the 1948 peak, with little likelihood of a drastic change in the immediate future. An adequate supply of materials, machinery, and manpower was also reported, with continued increases in labor productivity and efficiency of contracting organizations. These facts, emerging from a nation-wide survey of current construction conditions, were presented at the meeting for study.

Managing Director H. E. Foreman, in his annual report, predicted an annual $30,000,000,000 total volume of construction—two-thirds of it new and the rest for maintenance and repair—for the next few years. However, he said, such expectations must be tempered with the realization that developments both home and abroad could seriously affect the nation's economy. Mr. Foreman stressed the necessity of the industry's coping with market conditions, "ever-increasing inroads of day labor," trends toward the award of separate contracts, and good public relations. He emphasized maintenance of good relationships with legislative bodies, government agencies, specialty contractors' groups, and equipment and materials industries.

Huge Public Works Backlog

The backlog of accumulated need for public facilities of all sorts can be estimated as high as $100 billion, James W. Follin, M. ASCE, special assistant to the administrator of the General Services Administration, Washington, D.C., said in a talk before a luncheon meeting of the Building Contractors' Division. Analyzing the federal construction program, Mr. Follin stated that the program is not as large as is commonly supposed, and that a well-planned and continuing program of federal building construction could give substantial support to an expanding national economy and serve as a bulwark against depression.

Other ASCE speakers appearing on the five-day program included Dewitt C. Greer, Texas state highway engineer, who sounded the keynote of national highway problems with a warning that traffic may land a "knockout punch" on the nation's chin if substantial highway investments are not forthcoming; L. N. McClellan, chief engineer of the Bureau of Reclamation, Denver, who outlined improvements in specifications and the administration of Bureau contracts to meet the objections of general contractors; Capt. A. D. Hunter, deputy chief of the Navy Bureau of Yards and Docks, who discussed streamlining contractural relationships; and the late Laurence I. Hewes, M. ASCE, chief of the Bureau of Public Roads' Western headquarters in San Francisco, who reviewed methods of highway financing.

Action taken during the convention included endorsement of the AASHO recommended policy of federal-aid for highways. The convention also recommended that awarding agencies require general contractors to furnish all materials for projects to permit economies in purchases; that customary wage rate differentials and working conditions be maintained between highway and heavy construction and building construction "as conducive to maximum economy"; and that AGC members take more active part in apprentice training activities. Proposals for the establishment of valley authorities patterned after the TVA were condemned as "contrary to the principles of free competitive enterprise."

New officers installed were Walter L. Couse, M. ASCE, president of Walter L. Couse, & Co., Detroit, succeeding Adolph Teichert, Jr., of Sacramento, and Glenway W. Maxon, of Dayton, Ohio, as vice-president.

There was a record attendance of about 1,500.

AGC OFFICERS, PHOTOGRAPHED AT CLOSE OF recent convention in San Francisco, are left to right, vice-president Glenway W. Maxon; H. E. Foreman, managing director; president Walter L. Couse; and retiring president Adolph Teichert, Jr.

Mid-Winter Building Record Is Reported

A MID-WINTER BUILDING record is assured by a less-than-seasonal decline in construction activity during February, according to a joint announcement of the Construction Division of the Department of Commerce and the Labor Department's Bureau of Labor Statistics. Though the total value of new construction put in place in February, amounting to more than $1.4 billion, was off 5 percent from January, it was 21 percent above the total for February last year.

In terms of physical volume, as well as in dollars spent, the amount of new construction put in place during the past four months surpasses all previous mid-winter construction records, including war construction in the winter of 1941–1942, the two departments declare. A major share of this construction activity is attributed to home-building, exclusive of farms. Private residential building, totaling $600 million in February and accounting for more than half the total private outlay for new construction, was 50 percent above a year ago

Privately financed construction during the month reached $1,078 million, an increase of about 19 percent over the total for February 1949, despite a substantial drop over the year in industrial building and some falling-off in commercial and public utility construction. Public construction expenditures this February, placed at $336 million represented a decrease of 6 percent from January, largely as a result of seasonal decline in highway work. However, all types of public construction activity contributed to an increase of 26 percent over February 1949 in the total public construction volume.

Contract Given for Leeward Islands Work

WORK ON A $3,000,000 hotel and resort development in the Leeward Islands will get under way shortly, following the recent award of a design and construction contract to Hutchings & Milani, Ltd., and Bermuda-Caribbean Consultants, Ltd., Hamilton, Bermuda, according to an announcement from L. C. Milani, Jun. ASCE, president of the two firms.

4 important advantages

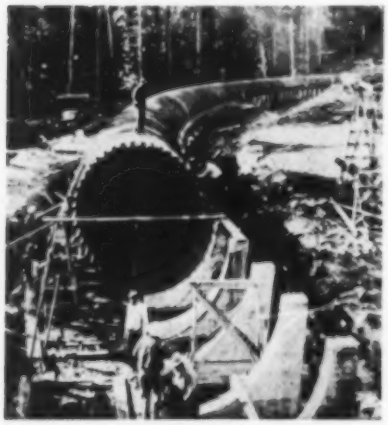
- Better wetting or coating of aggregate
- Greater stickiness and binding quality
- Faster setting of roads
- Blacker appearance

Now, you can build longer-lasting secondary roads in less time and at lower cost! Roads laid with the improved Standard Road Oils will wear longer because the aggregate is bound tightly into the road surface. Faster setting will mean less traffic delay. You'll do the job in less time.

Ask a Standard Oil Asphalt Representative for all the facts about these improved road oils. Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD

Huge Wooden Pipe Serves Power Project



SPECTACULAR WOOD PIPE installation, recently completed for California Oregon Power Co. between Medford and Yamsey, Ore., will divert water from Umpqua River for power development. Installation, consisting of 1,700 lin ft of continuous stave wood pipe, with inside diameter of 12 ft, is built largely on curves. To withstand high pressures, steel bands in two sections, connected with malleable iron pipe shoes, encircle and hold wood staves. Prefabricated at Los Angeles plant of Santa Fe Tank & Tower Co., pipeline was shipped in knocked-down form to site by rail and truck. Cost of construction and installation was about $165,000.

Aluminum Bucket Stands Up in Heavy Excavating

EXCELLENT RESULTS OBTAINED with aluminum excavator bucket in construction of new London Airport are reported in "Aluminum News." Fabricated from aluminum with steel lip plate, $^{5}/_{8}$-cu yd bucket handled more than 108,000 cu yd of sand during 14-month period, outlasting four new steel buckets. This record is attributed to light weight of aluminum bucket, which permitted it to strike ground lightly and to withstand heavy work with less shock. Photo courtesy of "Light Metals."

Navy Civil Engineer Officers Urged to Take Part in Society Affairs

IN HIS MESSAGE to the officers of the Civil Engineer Corps of the Navy, upon his appointment as chief of the Bureau of Yards and Docks, Rear Admiral Joseph F. Jelley M. ASCE, said in part:

"I am particularly concerned that we maintain and encourage by every means possible the fine Reserve organization that has been developed since the war. To these Reserves, I say: the Bureau of Yards and Docks will neglect no opportunity to make your active participation in the Reserve program both interesting and profitable.

"The Civil Engineer Corps is a young Corps. Approximately 45 percent of its officers are 30 years old or less. During the past few years we have been able to permit many of our officers to take special professional and technical training at service schools and civilian colleges. I have every expectation that we will be able to continue such training and even expand it as funds permit.

"Maintenance of the highest engineering standards continues to be of paramount importance, but the full professional development of our officers requires that they be assigned to billets which are more administrative than technical. The small size of the Corps demands officers who are administrators and leaders as well as competent engineers.

"This broadening of experience and professional development also can be helped along by joining national professional societies. Every Civil Engineer Corps officer, Regular or Reserve, should be a member of the American Society of Civil Engineers; or, if his basic engineering degree is in another line, the appropriate national engineering society. I also would recommend membership in the Society of American Military Engineers, as a means of understanding more clearly the problems and the accomplishments of the engineering branches of the other services. There are other very worth-while national professional societies specializing in various phases of engineering. In short, I urge you to take advantage of membership in any engineering or military society which will give you a broader view of your work and give you the opportunity to exchange ideas with other engineers and your fellow officers in the Department of Defense. Participation in society affairs, preparation of technical papers and other society activities will enhance the fine reputation the Corps and Bureau enjoy in the engineering profession."

Building Research Program Is Announced by BRAB

FORMATION OF INITIAL plans for the Building Research Advisory Board, recently set up in the Division of Engineering and Industrial Research of the National Research Council, is announced by William H. Scheick, newly appointed executive director. BRAB was established about a year ago at the request of the building industry to serve as a clearing house for information on building research and to stimulate additional research into promising, but neglected, fields of interest to the construction industry.

Mr. Scheick listed the following six specific projects that will be started immediately:

1. A survey to determine the urgent problems in the building industry susceptible to solution by research. This information will be sought by a canvass of research agencies, trade and professional organizations, and technical and research personnel in the industry.

2. A series of research correlation conferences to explore and evaluate subjects, review accomplishments, and chart future action.

3. Initiation of a detailed and long-term analysis of a "master outline" of building research and related fields to clarify the present picture.

4. Encouragement of government agencies concerned with building research to avail themselves of the advisory services of BRAB.

5. Cooperation with builders' and contractors' organizations to promote field tests and demonstrations of research results as a method of speeding up the practical application of technological advances.

6. Development of an effective program of publication and information.

These activities, to be carried on simultaneously, will form the basis of a five-year program that will be expanded further as additional funds and personnel become available.

Two Concrete Pipe Organizations Affiliate

EXPANSION OF THE activities of the concrete pipe industry by recent formation of the American Concrete Pressure Pipe Association, a non-profit corporation organized to promote the interests of the concrete pressure pipe industry, and its affiliation with the 43-year-old American Concrete Pipe Association, which has devoted itself mainly to concrete sewer and culvert pipe and concrete irrigation and drain tile promotion, is announced. Affiliation of the two groups was effected at the recent three-day convention of the concrete pipe industry held in San Francisco.

The two concrete pipe associations will coordinate their activities as members of a joint affiliating organization called Concrete Pipe Associations, Inc., under the direction of Howard F. Peckworth, M. ASCE, who will be managing director of all three organizations. Headquarters of the associations will be 228 North La Salle Street, Chicago, Ill.

Modern Buildings of the Future will be Fabricated by Arc Welding

Building for the David Bradley Manufacturing Works of Sears, Roebuck and Company at Kankakee, Illinois . . . designed by Sessions Engineering Company. All welded design permitted an unusually low steel weight of 6½ pounds per square foot of area, a saving of two to four pounds per square foot over standard riveted practice.

By E. O. SESSIONS
Sessions Engineering Co.
Chicago, Illinois

We have frequently submitted our continuous-beam rigid-frame welded designs along with alternate riveted designs to fabricators for comparative bids. Where the fabricator has had previous experience with welding of frame members, the bids for the welded designs have been similar or lower than for riveted designs.

Potential savings in the cost of fabricating structural members plus greater speed in the erection of buildings are two fundamental reasons why there will be a noticeable trend toward the welding of new buildings in the future. The construction industry, at present, is undergoing a gradual change in its basic concepts of structural design. When the present "growing pains" have been remedied, it is our belief that the greater percentage of industrial plants and multi-story buildings will be designed and erected by arc welding.

Our opinion results from 35 years experience in designing many different types of structures. Since 1934, however, we have specialized in engineering principally two types of industrial buildings, the welded rigid frame design and, where this has not been feasible, reinforced concrete design.

Upon casual observation of practically any riveted building framework, it becomes evident that there is an obvious excess of material and work required for this type of construction. Most riveted designs have deep trusses, small bays and are generally cluttered with reinforcing members, angles and plates. Welded designs, on the other hand, need only simple angles and butt plates welded to beams or columns with fast downhand arc welding techniques during shop fabrication.

As progressive architects and engineers become more experienced with welded structural designs, building specifications will insist on this type of construction rather than permit the choice of an alternate construction. While it requires more hours of designing time to turn out a properly designed welded structure, from our experience at least, the results more than justify the added effort.

GET THE FACTS

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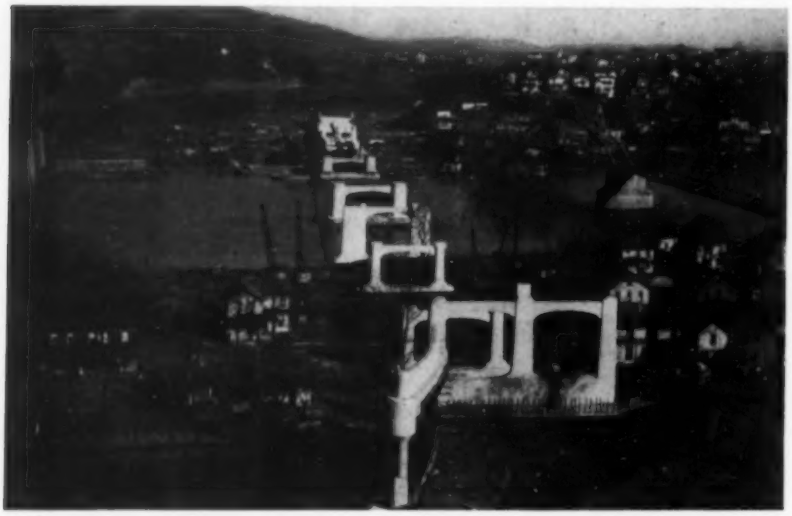
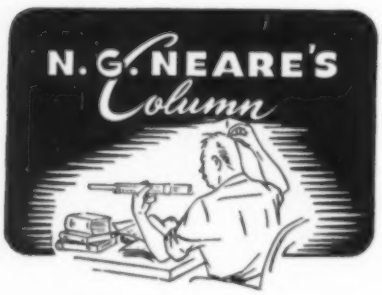
Monongahela River Bridge to Expedite Turnpike Traffic



SUBSTRUCTURE FOR NEW 2,000-ft, four-lane highway bridge across Monongahela River at Belle Vernon, Pa., was recently completed by Dravo Corp., Pittsburgh. Key project in Pennsylvania Highway Department's program to link Pennsylvania Turnpike at New Stanton with U.S. Route 40 at Washington, Pa., bridge will replace outmoded span, shown at right, and enable traffic between Ohio and the Turnpike to bypass Pittsburgh. Pennsylvania Highway Department is currently opening bids for erection of steel arch cantilever-type superstructure on these foundations, with construction scheduled to start this spring. Both substructure and superstructure were designed by L. A. Porter, bridge engineer for department, and construction of both is under L. J. Curran, district engineer at Uniontown. Dravo engineers on substructure project, which involved construction of eleven concrete piers, four of them in the river, and of large concrete abutments on each side, were B. N. Parker and R. B. Howard. Contract price of substructure project was $2,087,000.



R. Robinson Rowe, M. ASCE

"FUNNY THING," MUSED the Professor. "I just caught Joe Kerr chuckling to himself and thot he had the answer to the canoe problem, but he said, 'No, the canoe just reminded me of my first watch on a tin can when I was in the Navy and they sent me out to read the tide gage. I spent an hour on the witch-hunt and five bucks for the cigars afterwards. I was laughing to think that tide gages are standard equipment on battlewagons now.' Maybe Guest Professor Frack can get Joe to think about canoes again."

"I'll try, Noah. Joe, if you haven't the answer, will you tell us why?"

"I don't know why. After the race course was corrected to 12 furlongs, the problem reduced to the four continued equations:

$$x = \frac{a}{v} = \frac{b-a}{2p-v} + \frac{b}{p+v} = \frac{12-a}{2p-v} + \frac{12}{2p+v} = 5 + \frac{b}{p+v}$$

in which x was the time Ben was bareheaded, v was the velocity of the river, p was the incremental velocity per paddle, and a and b were distances from starting buoy to the buoys where Ben lost his bonnet and Bill broke his paddle, all in units of minutes and furlongs. But there are five unknowns, and I don't seem able to use the facts that a and b are integers and $a > 6$."

"I did," bragged Ken Bridgewater, "and found $a = 9$, $b = 11$, $p = 0.5$, $v = 0.6$ and the answer $x = 15$ min."

"Hocus pocus," scoffed Cal Klater. "Joe and Ken were paying too much attention to the race to see what was happening to the hat. One canoe moved away from it for 5 min and returned at half speed, which took 10 min more; total, 15 min. All the rest of the data was hocum."

"Exactly," said Professor Frack. "It's the simplest kind of relativity, typical of boat teasers—hard if you watch the race from the shore, but easy if you drift with the stream. The hocum included an easy but distracting diophantine minor theme."

"Which many preferred," added Professor Neare, "altho just as many bragged of solving by mental arithmetic and one contributed a neat figure of space-time vectors. The latter is Guest Professor Jenney, who has a new trick up his sleeve for our new problem. Dick likes easy ones and hard ones, so be ready for anything."

"All are easy after they are done, Noah. This one is medium, so I won't hide it behind a lot of hocum. I simply want to know the distance between two points inside a triangle. One point is distant 11, 14 and 19 cubits, respectively, from the 3 vertices; the other is at once equidistant from the 3 vertices and also from the 3 sides. If it's any easier, you can work it in varas instead of cubits."

[*There was a surprising number of Joe Kerrs who sent incomplete "insoluble" equations and probably a surprising number who didn't. Kens and Cals were: Guest Professor Richard Jenney, Anne Othernut (J. Charles Rathbun), Parker Piper (Julian Hinds), Ed C. Holt, Jr., G. Nyuss (Robert M. Dodds), Guy C. Thatcher, John L. (Stoop) Nagle, King Burghardt, E. P. (Eepee) Goodrich, Abbot A. Sackheim and Robert W. Woodbury. Guest Professor for the canoe race was J. L. Frack. Also acknowledged are solutions by Abraham Bodenstein and Robert H. Cummings for the December problems.*]

Steel Capacity of U. S. Exceeds Output of Rest of World

THE STEEL CAPACITY of the United States, now closely approaching 100,000,000 tons a year, exceeded by about 11,000,000 tons the combined output of all the rest of the world last year, according to the American Institute of Iron and Steel Construction. Announcing the results of its latest annual capacity survey, the Institute states that a capacity increase of 3,271,870 tons was achieved by steel companies during 1949 as the result of costly programs of expansion and improvement.

With last year's large increase, the industry has raised its total capacity nearly 18,000,000 tons, about 22 percent, since 1940. To support this great increase in steel-making capacity, there has been a corresponding rise in other productive facilities of the industry, such as blast furnace and coke oven capacity. A number of new rolling mills have also been added and other finishing facilities improved.

USBR to Request Bids on Several Construction Projects

ANNOUNCEMENT THAT BID calls may soon be expected on several Far Western construction projects is made by the Bureau of Reclamation. Developments on which contractors will be asked to bid include the Gila Project near Wellton, Ariz., where construction of a 30-mile-long concrete-lined section of Mohawk Canal, is required. The capacity of the canal will be 900 cfs, and the project will involve construction of 13 miles of protective and diversion dikes and outlet control structures. Time allowed for completion will be 750 days. Early reconstruction of the Gila Valley Canal Desilting Ba-

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2. Sand Mix
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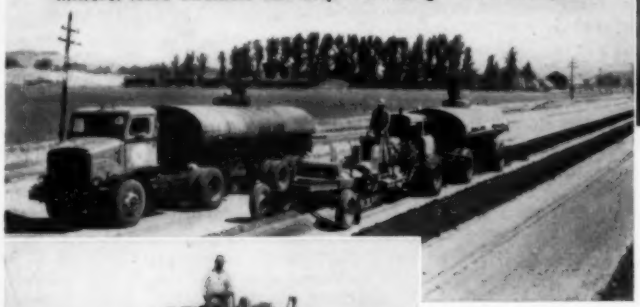
An Aleutian transport lands during runway construction. Bitumuls Sand-Mix although only partially cured — supports heavy loads.

"One-man" pavement construction in California with modern mixers. Note Bitumuls non-stop "refueling" from transport.



Florida builds low cost county roads by blade mixing existing sands with Bitumuls.

LOW COST PAVEMENTS from Native Material

Here was an Army Assignment:

"Build 6 big Airports in the Aleutians — in cold, wet weather — and fast. **No** access roads, and sound aggregate not available."

BITUMULS was the **answer.** It mixed easily with the wet existing sand, and cured in record time — Vital factors in repulsing Jap bombers.

Here was a Navy Assignment:

"Pave 1,700,000 sq. yds. of parking area for carrier planes. No local crushed aggregate available. The cost must be **low.**"

BITUMULS was again the answer. Nine Million Gallons stabilized 350 Acres of local sand—6" Deep. Conventional pavement would have required over **600 trainloads** of imported aggregate—at about three times the cost.

State and County Highway Engineers in the "Sandy" South appreciate the stability and low cost of **BITUMULS SAND MIX PAVEMENT.** In the U. S., there are over 25 million sq. yds. of this type of pavement in use. More is being constructed every year—the reasons:

1—Very Low Cost
2—Use of Existing Road Material
3—Ease of Construction
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Ask for our BITUMULS BOOKLETS. They are factual, illustrated, and helpful — a valuable addition to your engineering library.

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- Bitumuls for Maintenance . . . . . ☐
- Bitumuls Sand-Mix . . . . . ☐
- Bitumuls Handbook . . . . . ☐
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- Tennis Courts—Laykold & Grasstex . . ☐
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E. Providence 14, R. I. • San Juan 23, P. R. • Mobile, Ala.

sin, at the Arizona end of Imperial Dam near Yuma, will constitute another early Gila Project job.

On the Central Valley Project, near Lindsay, Calif., bid calls will soon be issued for construction of 69 miles of concrete pipelines for the Lindmore Irrigation District on the Friant-Kern Canal distribution system. The 12- to 48-in.-dia pipeline is to operate under a 20-ft head. About 400 days will be allowed for completion.

At Grand Coulee Dam, part of the Columbia Basin Project, construction of numerous buildings and utilities is contempated. Proposed projects include a 120 by 230-ft reinforced concrete machine shop, warehouses, and a central heating plant. Time allowed for completion will be 420 days.

NEW IN Education

TO ACQUAINT GRADUATE students with the materials of construction the Newark College of Engineering is giving a coordinated course on Materials of Engineering Construction, which will be required of all candidates for the master's degree in civil, chemical, electrical, and mechanical engineering. The course coordinates the materials entering into engineering structures, machinery, and equipment from the viewpoint of service as a function of variation of chemical composition, mechanical processing and fabrication, thermal processing, protection against deterioration and corrosion, as well as adaptation to special services.

THE RELATIONSHIP OF the engineer to conservation was featured at an all-day conference conducted by the Federation of Engineering Societies at Drexel Institute of Technology, Philadelphia. Speakers on the program, marking the first anniversary of the founding of the organization, included Dr. Clarence C. Cottam, assistant director, Fish and Wildlife Service, U.S. Department of the Interior; George Schobinger, vice-president, Day & Zimmermann, Inc.; Dr. Edward H. Graham, chief, Biology Division, U.S. Soil Conservation Department; Rudolph Diffenbach, coordinator, River Basin Studies, Department of the Interior; Samuel J. Leonard, Assoc. M. ASCE, professor of civil engineering, Drexel; and Theodore Davis, senior in the college of engineering at Drexel. Admiral Luis de Florez, U.S.N. Retired, inventor and consulting engineer, addressed the group on the need for ingenuity, common sense, and the creative spirit in engineering.

THE UNIVERSITY OF Kansas School of Engineering and Architecture recently was host to the first Soil Mechanics and Foundation Engineering Conference to be held in the state. Almost 150 engineers from Kansas, Nebraska, and Missouri registered for the all-day program, which included studies of soil mechanics in highway construction and on foundations and embankments. T. F. McMahon, assistant professor of civil engineering, was chairman of the conference, and G. W. Bradshaw, Assoc. M. ASCE, chairman of the department, presided.

UNDER A SPECIAL grant from the Research Corporation of New York, the hydraulics division of the Massachusetts Institute of Technology civil engineering department is studying possible applications of so-called analog computers to make hydraulic engineering predictions faster and more accurate. Out of the work, one of a number of basic engineering research studies in progress at MIT in the field of hydrodynamics, may come new ways of predicting accurately and rapidly the behavior of water in all kinds of complicated systems, according to Dr. Arthur T. Ippen, M. ASCE, professor of hydraulics. Use of the computers, for instance, can give immediate solutions to various flow problems.

AVAILABILITY OF TEN fellowships in traffic engineering for the academic year 1950–1951 is announced by the Yale University Bureau of Highway Traffic. These awards, which are open to engineering graduates of accredited colleges, are made possible through grants from the Automotive Safety Foundation and American Transit Association. Information regarding the fellowships, which have an approximate value of $1,400 each, may be obtained by writing to the Director, Bureau of Highway Traffic, Yale University, Strathcona Hall, New Haven 11, Conn.

A JOINT INVESTIGATION to determine the degree to which salt water has encroached upon fresh water supplies along the Atlantic Coast and Delaware Bay will be conducted at the University of Delaware. Cooperating organizations are the University, the Agricultural Experiment Station, the Delaware State Highway Department, and the U. S. Geological Survey.

A SUMMER PROGRAM of graduate work leading to an advanced degree in irrigation engineering will be available at Colorado A. & M. College. The programs offered in the two four-week summer terms will center around visiting lecturers of outstanding reputation in the field of irrigation science and special seminars on selected subjects. Requirements for enrolling are a bachelor's degree in civil engineering or successful completion of certain civil engineering courses, in addition to a degree in any other engineering field. For application blanks and further information address the Dean of Engineering, Colorado A. & M. College, Irrigation Institute, Fort Collins, Colo.

STEVENS INSTITUTE OF Technology is among the first engineering colleges in the country to offer a full-term course in prestressed concrete. The course, which starts with the spring semester, will be conducted by John E. Brett, Jun. ASCE, of the department of civil engineering. In addition to principles and methods of prestressing, the course will include laboratory studies of the properties of concrete and steel; the theory and design of simple and continuous beams, pipes and tanks; comparative design problems in reinforced concrete and in prestressed concrete; construction procedures; and the problem of cost.

University of Tennessee Dedicates Engineering Center

ENGINEERING INTERESTS OF ENTIRE COMMUNITY will be served by $994,000 engineering center dedicated by University of Tennessee College of Engineering on March 6. Consisting of two parallel sections connected by thick transverse section that encloses parking court, the 89-room structure will house civil and industrial engineering teaching and research work, administrative offices, cooperative training, extension courses, and professional society activities. Named Perkins Hall in honor of the late Dr. Charles A. Perkins, long-time member of engineering faculty, building was designed by engineering staff under direction of commercial architect.

Another technical editor confirms reasons why engineers prefer Gurley Aluminum Transits

Combining durability and lightness with precision for surveying transits

by David W. Veit
Editor, Die Castings Magazine

MANY surveying instruments built by W. & L. E. Gurley, Troy, N. Y., are accurate within one second of arc. If projected, this represents a maximum error of ⅝ inch in a mile.

However, precision is not the only requirement of these instruments. At least three other major factors influence the design and choice of materials for this type of equipment.

In the first place, a surveyor's transit must not only *be* accurate, but must maintain its accuracy over an indefinite period of years despite all sorts of weather and climatic conditions —heat, sub-zero temperatures, dampness, dust or salt-saturated atmospheres.

Second, it must withstand rough usage. This is outdoor equipment subjected to impact and abrasion.

The third requirement — no less important than the other two to the surveyor who carries the transit around all day long —is lightness.

The combination of accuracy and ruggedness could be secured by constructing the transit of heavy-sectioned castings, forgings or fabrications in steel or bronze, extensively machined and elaborately assembled. This choice of materials would, however, fail to include one significant feature—lightness.

The way in which Gurley has been able to combine all three desirable features has been by turning to aluminum for a major group of components. And since aluminum has been picked to fulfill the physical and mechanical needs of these surveyor's transits, it is not surprising that several of the most important parts are being produced most economically by die casting.

Die cast aluminum parts include the truss standard, telescope housing and leveling spider, as well as rod targets and tripod clamps. Aluminum alloys used for these transits have greater stability and rigidity than bronze. In addition, the die casting process permits unitary construction of the mounting frame, contributing further to rigidity.

From the point of view of weight reduction, aluminum die castings have permitted a 25 percent decrease in total weight, as compared with sand cast bronze. Die cast aluminum offers additional weight saving advantage, even as compared with sand cast aluminum, due to the thin, uniform wall section which is practical by die casting.

This pioneering instrument builder has used aluminum die castings wherever possible; this is one of the few production short cuts possible in a manufacturing operation characterized by extensive machining, finishing and assembling operations within close tolerances.

This company has maintained its leadership in the field of engineering and other types of instruments by a willingness to investigate and introduce into their production line the new materials and methods made available by technological advance. The excellent reputation of this company's instruments during the past century is sufficient testimony for the reliability of the materials which they use.

Reprints of the full-length article from which this is reproduced are available on request.

Field-proven over 74 years—Gurley Aluminum Transits are used from the Arctic to the Tropics. In the words of a combat engineer during World War II, "These instruments were subjected to the worst degree of heat, cold, mud, and dust a transit *should not* have. After being dropped, and everything else imaginable, they still did work up to par." The first Gurley Aluminum Transit was retired after 50 years of service to join the exhibit of Gurley "firsts." Gurley Instruments are described in Bulletin 50. Would you like a copy?

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Deceased

William Denham Barry (M. '49) vice-president and manager of the Austin Brothers Steel Co., Dallas, Tex., died on February 5. Mr. Barry, who was 51, spent his career with the steel company. A graduate of the University of Texas College of Engineering, he held membership in Tau Beta Pi, honorary engineering fraternity. He was a veteran of World War I.

Lucius Tullius Berthe (M. '19) president of the Berthe Engineering Co., Charleston, Mo., died on January 5. He was 73. Mr. Berthe had been in practice in Charleston for over 40 years, specializing in drainage and flood control work. He was educated at Purdue University.

Friedrich Bleich (M. '43) associated with the New York City consulting firm of Frankland & Lienhard, died suddenly on February 17, at the age of 71. A graduate of the Technical University of Vienna and consultant in Vienna until 1938, Dr. Bleich was responsible for the design of many notable bridges. Coming to this country in 1941, he was associated with Albert Kahn, Detroit architect and engineer, and later was engaged in research on the causes of the Tacoma Bridge disaster. He had been associated with Frankland & Lienhard since 1947, and at the time of his death was completing a survey on the buckling strength of metal structures under the firm's contract with the U.S. Navy. He was author of four books and numerous papers in the field of structural engineering.

Lee West Campbell (M. '44) assistant bridge engineer for the New Mexico State Highway Department, Sante Fe, N. Mex., died suddenly on January 23, at the age of 50. Except for a brief interval, Mr. Campbell had been in the department since 1923, and had been assistant bridge engineer since 1926. He had handled many difficult construction problems for the department, and had made a special study of the hydrology of the area.

Frederick William Cohen (M. '02) consulting engineer of Upper Montclair, N. J., died in New York City on January 26. He was 79 and a graduate of Rensselaer Polytechnic Institute. Mr. Cohen had been vice-president of the Metal & Thermit Corp., New York City, and earlier in his career was with the Pennsylvania Steel Co., at Harrisburg.

Harry Outen Cole (M. '10) who retired in 1945 as president of the Cole Bros. Construction Co., in Morgantown, W. Va., died there on February 13, at the age of 75. Mr. Cole served on the construction of the Panama Canal as assistant engineer in charge of designs with the Pacific Division; resident engineer on construction; and finally as division engineer in charge of Pacific Division. Later he was with Guggenheim Bros. on extensive construction projects in South America for the Chile Exploration Co. and the Braden Copper Co. Returning to Morgantown, his native city, in 1921, Mr. Cole had been instrumental in the engineering and civic development of the region, including the current project for development of the Monongahela River.

Samuel Forder Crecelius (M. '07) retired civil engineer of Corpus Christi, Tex., died there on July 30, 1949, according to word just received by the Society. Mr. Crecelius, who was 77, had done notable work in flood control as flood control engineer of San Antonio, and project engineer for the International Boundary Commission in charge of flood control of the Lower Rio Grande Valley. He had been city engineer of both Laredo and El Paso, Tex., and more recently was construction engineer for the Bureau of Reclamation on the building of Caballo and Green Mountain dams and the power plant near Kremmling, Colo. He served in both the Spanish-American War and the First World War.

Curt Henry Eiffert (M. '20) until recently chief engineer and general manager of the Miami Conservancy District, Dayton, Ohio, died on February 3, at the age of 66. Mr. Eiffert was with the District for 35 years, retiring January 1 because of ill health. He had been division engineer in charge of river channel improvements at Hamilton, Ohio, and upon completion of the district's construction program was transferred to Dayton as maintenance engineer. He had been chief engineer and general manager since 1925. Mr. Eiffert was a graduate of Cornell College, Mt. Vernon, Iowa.

Joseph Wilton Ellms (M. '13) until recently commissioner of sewage disposal for the City of Cleveland, died on February 7, at the age of 82. An expert on water purification, Mr. Ellms had been consultant on water and sewage problems for many cities. He was superintendent of the Cincinnati filtration plant for ten years before going to Cleveland in 1918 to serve as engineer of water purification. Later he was sanitary engineer, and from 1937 until his retirement last fall commissioner of sewage disposal. Mr. Ellms was prominent in the work of the American Water Works Association and other organizations, and had served as chairman of committees of the ASCE Sanitary Engineering Division. In 1940 he was awarded the Rudolph Hering Medal for Manual No. 19 on water treatment plant design.

William Tefft Haight (M. '45) senior bridge engineer for the California Division of Highways, Los Angeles, died on February 26, at the age of 56. A veteran of both World Wars, Colonel Haight was engineer of the Fourth Air Force in San Francisco in the recent war and holder of the War Department's Legion of Merit. Among engineering projects he directed in the state was work on the San Francisco-Oakland Bay Bridge. He was a graduate of City College of New York and, at one time, had been with the New York and New Jersey highway departments.

Aaron Gretzner Levy (M. '20) chief civil engineer in the Utilities Department of the City of Cleveland, was fatally stricken in his office on February 20 and died a day later. Mr. Levy, who was 65, had been in the Cleveland municipal service since 1919. Earlier he was head of the New Orleans water purification division. A veteran of the first World War, Mr. Levy was active in the American Legion and a Mason. He was a graduate of Tulane University.

Laurence Isley Hewes (M. '19) since 1920 chief of the Western Region of the Bureau of Public Roads, San Francisco, Calif., died on March 2, a day after addressing the 31st annual convention of the Associated General Contractors of America. Dr. Hewes, who was 74, had been with the Bureau of Public Roads since 1911. Distinguished as both a mathematician and engineer, with degrees from Dartmouth College and Yale University, Dr. Hewes taught in several colleges during his early career. He was author of several college textbooks on highway engineering and mathematics, including the standard *American Highway Practice*. Recently Secretary of Commerce Sawyer awarded him a gold medal for meritorious service in the Commerce Department.

Laurence I. Hewes

Allan Bruce Lincoln (M. '45) job manager for the Mason & Hanger Co., of New York, died suddenly on March 8 in Yankton, S. Dak., on his way to direct his company's contract on Fort Randall Dam. He was 49. A graduate of Rutgers University, class of 1927, Mr. Lincoln was a field engineer for the Port of New York Authority on the New Jersey approaches to the George Washington Bridge and resident engineer on construction of the Lincoln Tunnel. He had been with Mason & Hanger since 1939, recently as job manager on building the Manhattan section of the Brooklyn-Battery Tunnel.

Charles Rex Little (Assoc. M. '34) executive secretary of the Ohio Valley Conservation and Flood Control Congress, Cincinnati, Ohio, died there on January 8. He was 48. Earlier Mr. Little had been conservation and flood control engineer for the Mid-West region of the Portland Cement Association, and during the war served as an officer in the Field Artillery. He was a graduate of Purdue University.

Francis Conover McMillan (M. '28) for the past 30 years engineer for the Los Angeles County Flood Control District, died at his home in Little Rock, Calif., on February 25. He was 67. A veteran of World War I and major in the Army Engineer Reserve, Mr. McMillan had been active in the American Legion and was past commander of the East Pasadena post.

Clarence Edmund Seage (Assoc. M. '14) consulting engineer of San Francisco, Calif., died on February 6, at the age of 61. His home was in Oakland. In practice in San Francisco for many years, Mr. Seage was engaged on the design of the San Francisco-Oakland Bay Bridge and other notable structures.

John Edward Stirling Thorpe (Assoc. M. '16) president of the Nantahala Power & Light Co., a subsidiary of the Aluminum Company of America, died at his home at Franklin, N.C., on February 24. He was 62. A Britisher by birth, Mr. Thorpe was

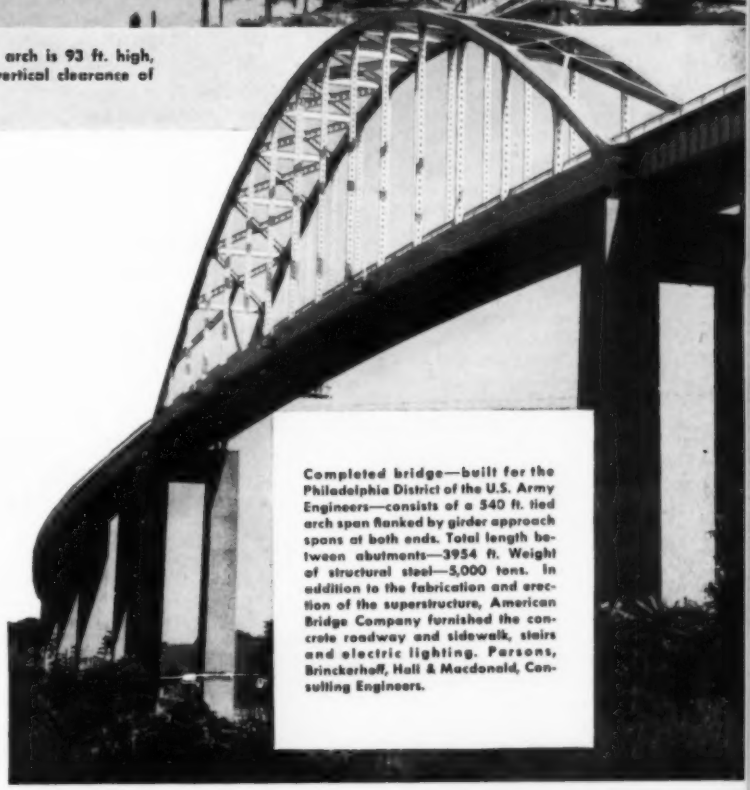
(*Continued on page 76*)

Dual erection methods solve arch construction problem

Erection of arch span, showing falsework and toggle bent. The arch is 93 ft. high, centerline rib to centerline of tie at mid-span, and provides a vertical clearance of 135 ft. at mean high water.

• In erecting the new highway bridge over the Chesapeake and Delaware Canal at Chesapeake City, Md., the problem was to provide a safe channel for navigation during erection. Therefore only one falsework bent could be used. American Bridge engineers solved this difficulty by an unusual combination of erection methods, using a falsework bent at the south side of the canal and a toggle bent over the north pier.

This engineering know-how – this wide experience in successfully meeting special situations on jobs of every size and type—is available to you on your own jobs, large or small, through our nearest Contracting Office.



Completed bridge—built for the Philadelphia District of the U.S. Army Engineers—consists of a 540 ft. tied arch span flanked by girder approach spans at both ends. Total length between abutments—3954 ft. Weight of structural steel—5,000 tons. In addition to the fabrication and erection of the superstructure, American Bridge Company furnished the concrete roadway and sidewalk, stairs and electric lighting. Parsons, Brinckerhoff, Hall & Macdonald, Consulting Engineers.

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USS

AMERICAN BRIDGE

UNITED STATES STEEL

(*Continued from page 74*)

educated at Johns Hopkins University. In 1915 he joined an Alcoa subsidiary as resident engineer and had served the company since in many responsible capacities. In 1929 he was named to the position he held at the time of his death. He was also president of the Southeastern Electric Exchange.

Raymond Smith Topper (Assoc. M. '27) senior partner in the structural engineering and steel contracting firm of Topper & Griggs, West Hartford, Conn., died suddenly on February 21. He was 58. From 1913 to 1920 Mr. Topper was with the Maritime Bridge Co., and the Nova Scotia Steel & Iron Co., Canada, and from the latter year to 1923 served as conduct manager for the Porcupine Co., steel fabricators of Bridgeport, Conn. In 1923, with E. F. Griggs, he founded the partnership of Topper & Griggs, and for many years was engaged in the design and sale of structural materials.

Lawrence William Wells (M. '06) retired consulting engineer of Dallas, Tex., died at his home there on October 5, 1949, at the age of 82. A graduate of the University of Georgia, Mr. Wells was for many years general manager of the Texas Midland Railroad, with headquarters at Terrell. He retired some years ago.

NEWS OF Engineers

Adolph J. Ackerman, director and vice-president in charge of hydroelectric construction of the Brazilian Technical Services and Management Co., São Paulo, Brazil, has in addition been elected director and vice-president in charge of engineering of the Canadian-Brazilian Services, Ltd., of Toronto, Ontario. Prior to 1948 the latter organization operated under the name of Canadian and General Finance Co.

James I. Corbett has become associated with the consulting engineering and architectural firm of Hitchcock & Estabrook, Inc., of Minneapolis, Minn. Mr. Corbett served as city engineer of Menominee, Mich., for many years.

Lt. Col. Clarence C. Davis, Corps of Engineers, has been appointed resident engineer on the construction of Detroit Dam on the North Santiam River, in the Portland, Ore., District of the Corps.

George Tongue is now superintendent of maintenance and construction with the Dallas Railway & Terminal Co., Dallas, Tex.

Warren C. Taylor, after 40 years of service more recently as professor and chairman of the department of civil engineering at Union College, will retire in June. He will be succeeded by **H. Gilbert Harlow,** associate professor of civil engineering, who received his master's degree at Harvard in 1940.

H. R. Oglesby, Jr., was recently appointed manager of the Municipal Service Co., contracting engineers of Kansas City, Mo., a J. F. Pritchard & Co. subsidiary.

Lawrence Parker, General Services Administration engineer, has retired from government service. During the war Mr. Parker designed many shore facilities for the Coast Guard.

Willard J. Turnbull, chief of the Soils Division of the Waterways Experiment Station at Vicksburg, Miss., was among the engineers to receive a Corps of Engineers award for a joint suggestion on using a mixture of mud to secure sub-surface undisturbed sand samples.

James I. Ballard, formerly in the New York office of *Engineering News-Record,* has accepted the position of editorial director of *Western Construction News.*

Walter Samans announces the establishment of a consulting engineering practice, specializing in unfired pressure vessels and tanks, under the firm name of Walter Samans, with headquarters at 1616 Walnut Street, Philadelphia, Pa.

Thomas H. MacDonald, commissioner of public roads, U.S. Bureau of Public Roads, Washington, D.C., and **Edwin W. James,** chief of Public Roads' Inter-American regional office in Washington, were recently presented gold medals by the Commerce Department in recognition of their outstanding achievement in government service. Other ASCE members to receive awards are **Joseph Barnett,** chief of Urban Road Branch of Public Roads; **Carl F. Izzard,** chief of Hydraulics Branch; and **William T. Pryor,** highway engineer assigned to the division engineer in charge of road construction in eastern national forests and parks.

J. G. Wright has become a partner in the civil engineering firm of Earl & Wright, of San Francisco, Calif. Mr. Wright previously held the title of chief engineer in the firm headed by Austin W. Earl.

Bernard E. Gray, for the past 40 years in the construction and maintenance field, has been named president of the Asphalt Institute.

Chi Epsilon Fraternity Honors Society Members

CHARLES GILMAN HYDE and David B. Steinman, Members ASCE, were elevated to the grade of National Honorary Member by Chi Epsilon, honorary civil engineering society, at the recent Eleventh Biennial Conclave of the organization at Raleigh, N.C. In its 28 years of existence the fraternity has elected only 16 national honorary members, including the two present recipients. All have been members of ASCE.

The fraternity was the guest of North Carolina State College, where Ralph E. Fadum, Assoc. M. ASCE, heads the department of civil engineering. During the two-day program Clarence L. Eckel, M. ASCE, dean of engineering, University of Colorado, was elected President, and Willard F. Babcock, Assoc. M. ASCE, assistant professor of civil engineering, North Carolina State College, Vice-President. National councillors are Douglas M. Stewart, Rochester, N.Y., businessman; Robert B. B. Moorman, M. ASCE, professor of civil engineering, University of Missouri, and Harold T. Larsen, M. ASCE, editor of Technical Publications, ASCE.

Harry C. Vensano, who recently resigned as director of public works of San Francisco, Calif., after seven years of service, has resumed practice as a civil and structural engineer, with offices at 320 Market Street, San Francisco. Mr. Vensano has had a career of 46 years in the design, construction, and construction management fields. He will be succeeded as director of public works by **Sherman P. Duckel,** who has served the city for about 23 years.

Harry C. Vensano

Col. John S. Seybold, for the past three years district engineer for the Corps of Engineers at Garrison, Nebr., has been transferred to the Missouri River Division at Omaha.

Ross H. Bryan has formed a partnership for the practice of structural engineering under the firm name of Bryan & Dozier, Nashville, Tenn., Mr. Bryan has been associated with Marr & Holman of the same city.

Severud-Elstad-Krueger, consulting firm of New York City, is successor to the firm of Fred N. Severud.

John D. Argetsinger has gone to Juneau, Alaska, where he will head a new office for the General Services Administration. Formerly, he was district engineer for the Community Facilities Services, GSA, at St. Paul, Minn., and Kansas City, Mo.

J. Wayne Courter has accepted the position of division construction and maintenance engineer with the Bureau of Public Roads at Fort Worth. He previously served the Bureau in Austin as district bridge engineer.

The name of the firm of **Caldwell-Scott** Construction Co., Inc., of Fort Lauderdale, Fla., has been changed to Caldwell-Scott Engineering and Construction Co., Inc.

ASCE members recently appointed to the newly created California State Water Pollution Control Board and regional board include, **Edward Hyatt,** ex officio member of the State Board; **John S. Longwell,** chairman of the San Francisco Bay Region; **Ralph Wadsworth,** member of the San Francisco Bay Region; **Neal D. Smith,** chairman of the Central Coastal Region; and **Carl M. Hoskinson,** chairman of the Central Valley Region.

(*Continued on page 79*)

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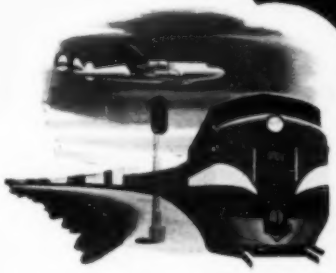
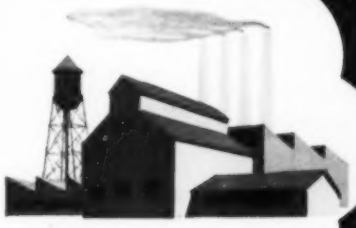
LOGGING



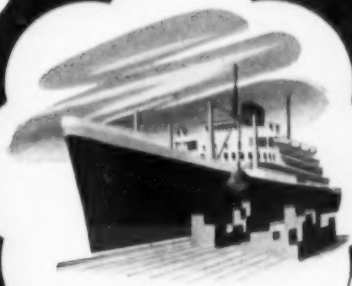
TRANSPORTATION

MINING

PETROLEUM



MANUFACTURING



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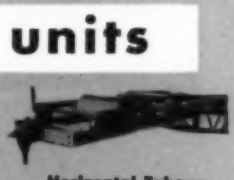


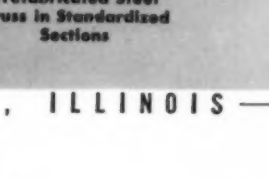
Horizontal Takeup

Screw Takeup

Vertical Takeup

Belt Scraper

Back Stop Brake



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(*Continued from page 76*)

Charles S. LeCraw, Jr., previously resident traffic engineer of the Eno Foundation for highway traffic control, Sangatuck, Conn., has joined the Ramp Buildings Corp., national consulting organization on the planning and development of automotive parking facilities, as assistant vice-president, with headquarters in New York City.

Robert M. Angas, Russell H. DeGrove, and **Richard L. Lampp** announce the formation of a partnership to engage in the practice of civil engineering and surveying under the firm name of Robert M. Angas & Associates, with offices at 420 Hildebrandt Building, Jacksonville, Fla.

A. C. Shire, former Washington, D.C., consultant, has been appointed chief of the Housing Technology Branch of the New Housing and Home Finance Agency's Division of Housing Research, in Washington, D.C. In this capacity, Mr. Shire will have charge of all activities in the division designed to improve housing construction and achieve lower construction costs through technological advances.

Mervin J. Barrick has resigned as district sanitary engineer for the Pennsylvania State Department of Health at Williamsport.

Howe & Wise, Houston, Tex., consultants, have opened a branch office in San Antonio, placing **J. R. Spiller** in charge.

John A. Bitterman, who has been connected with the Kentucky Department of Highways for approximately 27 years, has been named director of the recently formed Division of Materials and Testing with a special laboratory at Frankfort.

Robert L. Hall, formerly associated with Ralph Woolpert Co., consultants, is now with the City of Dayton, Ohio, as waterworks engineer in the Department of Water.

Clarence B. Shain has resigned as city engineer of Pasco, Wash., to open a consulting office at Olympia.

Arthur D. Edmonston, since 1945 assistant state engineer of California State Department of Public Works, has become state engineer at Sacramento. From 1927–1945 Mr. Edmonston served as principal hydraulic engineer and deputy state engineer in charge of water investigations and other activities of the Division of Water Resources.

John E. Wiley, connected with the Wyoming State Highway Department for the past 17 years, has resigned to accept a position as assistant secretary of the American Association of State Highway Officials. Mr. Wiley is credited with the organization of four new highway departments.

Sidney McFarland, who was recently awarded the Society's Daniel Mead Prize for Juniors, has been transferred by the Bureau of Reclamation from Sacramento, Calif., to Washington, D.C.

G. A. Anderson, previously with the Bram well Construction Co., of San Francisco, Calif., and the Del E. Webb Construction Co., of Emeryville, has been appointed manager of Hoffman Development Co., at Portland, Ore.

Raymond W. Stuck, since 1946 chief of the Engineering Division of the Civil Works Division of the Office of the Chief of Engineers, has become chief engineer of the Hanford Works of the Atomic Energy Commission, at Richland, Wash.

A. F. Ghiglione is now chief engineer of the Alaska Road Commission with headquarters in Juneau.

At a recent meeting of the Ohio Section of the American Water Works Association the George W. Fuller prize was presented to **W. W. Morehouse,** Dayton, Ohio, water director, and the Wendell L. LaDue Award to **Myron Tatlock,** of the Ralph Woolpert Co., also of Dayton.

F. S. Godbold, district civil engineer for the Humble Oil & Refining Co., has been transferred from the organizations Opelousas, Tex., gas plant construction district to its London district in the East Texas Division. **A. H. Behling,** junior civil engineer, is now at the East Texas Division Office, with headquarters at Tyler. **Guy F. Radley,** assistant civil engineer, has been transferred to the North Texas Division in Wichita Falls. Other transfers include **Robert F. Wipke** in the East Texas Division at Tyler, and **John E. Buehrig,** district civil engineer, to the North Texas Division, at Winters.

Fred Scobey, ASCE Vice-President of Zone IV, Berkeley, Calif., recently retired from the U. S. Department of Agriculture. He is an authority in the field of hydraulics and has maintained a consulting practice for a number of years.

Kirby V. Jones is in the employ of the J. A. Jones Construction Co., of Charlotte, N.C., serving as estimator for preparation of bids on heavy construction projects. The Jones Co. is joint venturer on construction of Clark Hill, the Pine Flat, and the McNary dams.

ASCE Members Elected to Water Works Posts

SEVERAL SOCIETY MEMBERS have been elected to the roster of officers of the American Water Works Association for a term beginning at the close of the organization's annual conference, to be held in Philadelphia the end of May, and extending to the close of the 1951 annual conference.

W. Victor Weir

W. Victor Weir, M. ASCE, superintendent and chief engineer of the St. Louis County Water Co., and the Missouri Water Co., St. Louis, will be president of the association, succeeding Dr. A. P. Black. William W. Brush, M. ASCE, editor of the Case-Shepperd-Mann Publishing Corp., New York City, was reelected treasurer, and Harry E. Jordan, Aff. ASCE, of New York City, was reelected secretary.

Meetings and Conferences

American Geophysical Union. Headquarters for the 31st annual meeting of the American Geophysical Union are to be in Washington, D.C., May 1–4.

American Society of Mechanical Engineers. A symposium on turbo-jet anti-icing will be presented during the spring meeting of the American Society of Mechanical Engineers at the Hotel Statler, in Washington, D.C., April 12–14.

American Society of Tool Engineers. New processes and equipment will be displayed during the industrial cost-cutting exposition sponsored by the American Society of Tool Engineers in Philadelphia, Pa., April 10–14. An economy forum will be held at the Academy of Music, Philadelphia, on April 10.

Midwestern Conference on Fluid Dynamics. Headquarters for the Midwestern Conference on Fluid Dynamics will be the University of Illinois, Urbana, Ill., on May 5 and 6.

New Jersey Society of Professional Engineers. The 26th annual convention of the New Jersey Society of Professional Engineers will take place at the Essex House in Newark, N.J., April 14 and 15.

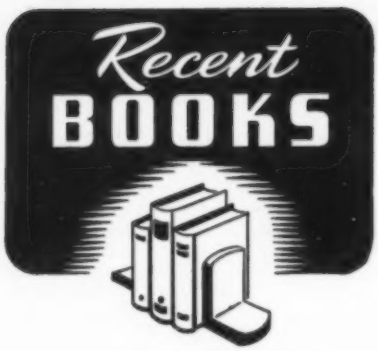
Ohio Welding Engineering Conference. Economy in design and production is the theme of the 11th Ohio State Welding Engineering Conference, which will be held on the campus of the Ohio State University, Columbus, April 14–15.

Process Industries Division Conference. The Process Industries Division and the Pittsburgh Mechanical Engineering Conference, sponsored jointly by the Process Industries Division, and the Pittsburgh section of the ASME, with the cooperation of the Engineers Society of Western Pennsylvania, the Society for the Advancement of Management, and the American Materials Handling Society, will be held at the Hotel William Penn, Pittsburgh, Pa., April 24–27.

Producers' Council, Inc. Recent developments in building research will be discussed at the spring meeting of the Producers' Council, Inc., national organization of building product manufacturers, in Washington, D.C., May 9 and 10, to be held concurrently with the annual convention of the American Institute of Architects.

Society for Experimental Stress Analysis. Various techniques of stress measurement will be presented at the Spring meeting of the Society for Experimental Stress Analysis, at the Statler Hotel, Cleveland, Ohio, May 25–27. Inquiries should be addressed to the Society for Experimental Stress Analysis, P.O. Box 168, Cambridge 39, Mass.

Society of Automotive Engineers. A national aeronautic meeting and aircraft engineering display of the Society of Automotive Engineers is scheduled for the Hotel Statler, New York City, April 17–20. An earthmoving industry conference will be sponsored by the Central Illinois Section of SAE in Peoria, Ill., April 11 and 12.



CONTRIBUTION A L'ÉTUDE DES PERTES DE CHARGE SINGULIÈRES (Publications Scientifiques et Techniques du Ministère de l'Air.) By C. H. Cottignies. Service de Documentation et d'Information Technique de l'Aéronautique, Magasin C.T.O., 2 Rue de la Porte-d'Issy, Paris 15e, 1949. 107 pp., illus., diagrs., charts, tables, 10½ × 7 in., paper, 420 Frs. This publication presents an analysis of fluid flow and loss of head in piping systems having abrupt changes of direction or cross-section. Use is made of supersonic nozzles to provide a constant, sufficiently high rate of flow as a basis for the calculations. The equipment and the characteristics of supersonic flow are described in introductory chapters.

DAS CROSS'SCHE VERFAHREN. By W. Dernedde and A. Müllenhoff. Verlag von Wilhelm Ernst & Sohn, Berlin, 1948. 107 pp., diagrs., charts, tables, 9¼ × 6½ in., paper, 12 DM. This book is a German exposition of the Hardy Cross method of step-by-step analysis of continuous beams and frameworks. Literature references to German, English, and Dutch articles are given.

DURCHLAUFTRÄGER, VOL. I. 7th rev. and enlarged ed. By A. Kleinlogel and A. Haselbach. Verlag von Wilhelm Ernst & Sohn, Berlin, 1949. 271 pp., diagrs., tables, 9½×6 in., paper. 20 DM. Readily usable formulas and numerical tables together with detailed theoretical development and calculation of all practical common continuous girders for any given external and internal stress are provided in this book. Emphasis is placed on the most frequently occurring special types of stresses.

EARTH WAVES (Harvard Monographs in Applied Science No. 2.) By L. D. Leet. Harvard University Press, Cambridge, Mass.; John Wiley & Sons, New York, 1950. 122 pp., diagrs., charts, tables, 8½×5½ in., cloth, $3. Based on a course of lectures given in 1946 for the Lowell Institute of Boston, this book presents a compact summary of our knowledge about waves in the earth. Applications in the fields of prospecting for minerals, studying hurricanes, measuring vibrations from dynamite blasts, and mapping broad earth structures are discussed. Results of recent research on types of wave motion, interpretation of refraction profiles, and microseisms are included.

HAVENTECHNIEK, Eerste Internationaal Congress held at Antwerp, 16 to 19 June, 1949, Jubileum V.I.V. 1928–1948. Vlaamse Ingenieursvereniging, Torengebouw VIII, Schoenmarkt 31, Antwerp, Belgium. Illus., diagrs., charts, maps, tables, 11½×9 in., stiff cardboard, 500 Belgian Frs. This volume contains 50 of the papers presented at the first International Congress on Harbor Engineering. The four subject groups included are: (1) Harbor works; (2) equipment used in harbor work; (3) treatment for the preservation of perishable plant and animal products; and (4) safety in harbors. The papers are in Dutch, French, or English with abstracts in Dutch, English, French, and German.

L'ÉCOULEMENT EN CONDUITES DES LIQUIDES, GAZ ET VAPEURS, Les Lois de l'Écoulement, La Mesure des Débits. 2 ed. By A. Schlag. Dunod, Paris, 1949. 254 pp., illus., diagrs., charts, tables, 7½×5 in., paper, 850 Frs. The flow of liquids and gases in pipes and conduits of various cross-sections is discussed in detail. Resistance to flow and pressure-drop calculations are covered, and flow meters are described including the measurement of pulsating flow. In addition to the full theoretical treatment examples of practical application are given. There is a bibliography.

MATHEMATICS DICTIONARY. Edited by G. James and R. C. James. D. Van Nostrand Co., Toronto, New York, London, 1949. 432 pp., diagrs., tables, 9¼×6 in., cloth, $7.50. The earlier version of this dictionary covered terms in the range beginning with arithmetic and extending through the calculus. In the new edition basic terms have been added for metric differential geometry, theory of functions of real and complex variables, differential equations, theory of groups and of matrices, point-set topology, analytic mechanics, theory of potential, and statistics. Frequently used formulas appear in the context, and an appendix contains basic mathematical symbols and useful tables.

PUMP QUESTIONS AND ANSWERS. By R. Carter, I. J. Karassik and E. F. Wright. McGraw-Hill Book Co., New York, Toronto, and London, 1949. 346 pp., illus., diagrs., charts, tables, 9¼ × 6 in., cloth, $5. This book covers the construction, application, operation, installation, and maintenance of pumps. In five major sections, centrifugal, vertical turbine, regenerative, rotary, and reciprocating pumps are dealt with separately.

ROUTE SURVEYING. By C. F. Meyer. International Textbook Co., Scranton, Pa., 1949. 300 pp., illus., diagrs., charts, tables, 7¼×4¼ in., cloth, $6. Designed as a reference for practicing civil engineers and as a text for civil engineering students, this book presents the technical principles of the subject and their practical applications in curve or earthwork problems. More than half of the book contains tables set up in a form especially useful in route-survey calculations. Short bibliographies are included on curve problems in highway design and highway surveys.

(Der) STAHLBETONBAU, WERKSTOFF, BERECHNUNG UND GESTALTUNG. 7th ed. By R. Saliger. Franz Deuticke, Vienna, 1949. 644 pp., diagrs., charts, tables, 10×7 in., paper, 66 Sw. Frs.; bound $15.18. Intended for use both as a textbook for civil engineering students and handbook for practicing engineers, this book considers the materials, calculations and construction principles of reinforced concrete. It contains detailed discussions ranging from the production of concrete to the design and construction of bridges and buildings. Numerous charts provide useful data, and a bibliography is included.

STRENGTH OF MATERIALS. By B. B. Low. Longmans, Green & Co., London, New York, and Toronto, 1949. 231 pp., diagrs., charts, tables, 8¾ × 5½ in., cloth, $2.50. Intended for students and engineers who want an introductory study, this book provides the elementary theory necessary for solving necessary problems and gives explanations of the most important aspects of the subject with numerous worked examples. Problems for student exercise and their answers are included.

TASCHENBUCH FÜR BAUINGENIEURE. Edited by F. Schleicher. Springer-Verlag, Berlin, Göttingen and Heidelberg, 1949. 1942 pp., illus., diagrs., charts, tables, maps, 8×5 in., cloth, 36 DM. This standard reference work contains the basic material used in all branches of civil engineering. In this corrected version of the 1943 edition, the major sections include mathematics, mechanics of solids and fluids, strength of materials, construction materials, measurements, road building, railroad construction, soil mechanics, water supply, dams, and steel construction.

THE FIRST TRANSCONTINENTAL RAILROAD. By the late John D. Galloway, Hon. M. ASCE. Simmons-Boardman, New York, 1949. 319 pp., 6¼×9¼ in. cloth, $5. The subtitle might read "noted engineer pictures greatest construction feat of the nineteenth century." Here is an expert's calm story of a heroic contest with nature and humanity in the rough. Two railroad giants, the Central Pacific moving east from Sacramento up the steeps of the Sierras and the Union Pacific across the plains westward from Omaha vied for supremacy, finally meeting at historic Promontory Point in Utah. For each in turn, Mr. Galloway reviews the personalities, the surveys and the construction. In this epic the engineer, notably Theodore D. Judah, M. ASCE, at the west, and Peter A. Dey and Gen. Grenville Dodge, Hon. M. ASCE, on the east showed their mettle. The first forfeited his life, the second his greatest ambition, while the third wrestled every odd to a successful conclusion.

More Knowledge of River Regimen Theory Needed

(*Continued from page 50*)

of authorized canal discharges, has more irrigation than the whole United States, and every canal is laden with sediment. The vagaries of rivers prevent their exact analysis to discover the principles governing their regimen. Canals, on the other hand, are not permitted to meander, and their discharges are controlled closely. Distributing channels are normally run full or else closed.

The highlights of Lacey's regimen theory for the present purpose are:

If the long-term sediment load of a system, irrespective of very considerable short-term variations, is fixed, then the channels will settle down to a practically steady regimen in which

1. The Froude number in terms of depth is fixed.

2. The rate at which gravity does work on the fluid per unit of mass discharge is fixed.

3. The slope depends on the inverse sixth root of the discharge.

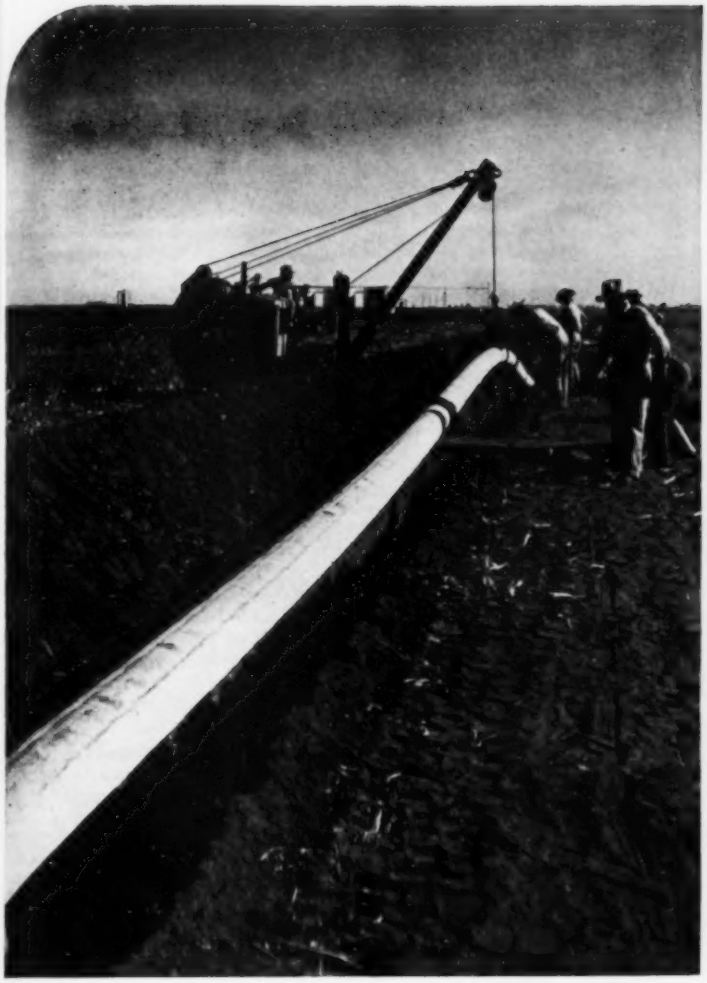
These laws control the behavior of rivers that build up a flood plain. Their detailed application requires some care to allow for meandering, variations of discharge and heterogeneity of banks. But these practical difficulties do not alter the fact that the same laws are at work in rivers as in canals.

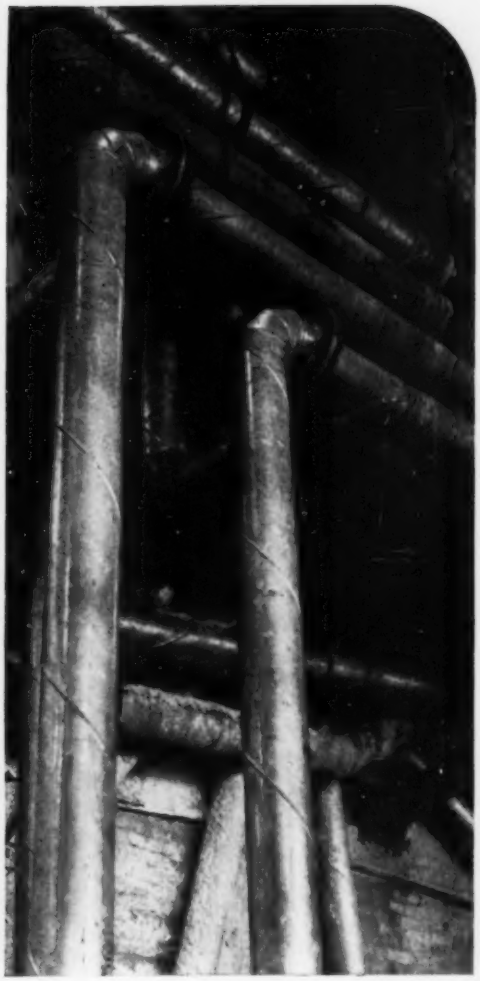
For simplicity, suppose that the Rio Grande was exactly as it was before man's cultivation methods, etc., increased the sediment load, and that a dam were built across it. The river must deposit a delta and cut its way through it. The river cannot perpetually run horizontally in the delta; it must deposit sediment and try to get back to the regimen slope which it had for centuries. So, as the delta advances, the river keeps trying to get back to its old slope, but with the pivotal point at the nose of the advancing delta. Ultimately, excluding secondary effects, the river must raise the whole of its flood plain by the height of the dam. This deposition may take centuries, depending on the sediment available and the size of the valley to be filled, but a couple of decades may suffice for a rise of several feet at the original lake head.

On the Indus system, low dams similar to that on the All American Canal have been built progressively since the 1880's. The effect on the rivers has been analyzed officially and found to be exactly what Lacey's law would require; that is, upstream of a dam a river gradually adjusts itself parallel to its old slope until the next dam upstream is encountered. Were regimen theory more widely understood I feel that the damming of regimen-type rivers would not be undertaken as enthusiastically as it is at present.

T. BLENCH, M. ASCE
Associate Professor of Civil Engineering
University of Alberta

Edmonton, Alberta, Canada





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New Publications

Highway Engineering. A new highway engineering recruitment booklet, *Highway Engineering, A Challenge and an Opportunity*, has been published by the American Road Builders' Association as part of its drive to assist federal, state, county, and local road units in overcoming a serious shortage of highway engineers. Prepared by the Advancement of Highway Engineering Committee of ARBA, the 44-page booklet is designed to acquaint college students and others with the possibilities and scope of highway engineering. The booklet sells for 50 cents, and reduced prices on lots on 50 or more are available, upon application to the ARBA, 1319 F Street Northwest, Washington 4, D.C.

Construction Contracts. The nature and functions of the construction contract bond, and the advantages accruing from the bonded contract to owner, architect and engineer, contractor, subcontractor, and supplier, are discussed in a recent booklet issued by the Surety Association of America. Entitled *Construction—The Bonded Contract Is the Owner's Protection*, the publication is being distributed free of charge to the construction industry, private owners, public awarding officials, colleges, and libraries by the Surety Association of America, 60 John Street, New York 7, N.Y.

Industrial Water Standards. A recent compilation, prepared by the American Society for Testing Materials Committee D-19 on Industrial Water, assembles in convenient form ASTM standard methods of sampling, analysis, and testing of industrial water. Copies of this 142-page publication may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., at $1.75 each.

Atomic Energy. New accomplishments in the Nation's long-range program for the peacetime development of atomic energy are explained in the *Seventh Semiannual Report of the Atomic Energy Commission*, dated January 1950. Much of the 228-page publication is devoted to developments in the field of research. Inquiries regarding the publication should be addressed to the Government Printing Office, Washington 25, D.C.

Waste Disposal. Proceedings of the Fourth Industrial Waste Conference, held at Purdue University in September 1948, have been issued by Purdue University as Extension Series No. 68 of the Engineering Extension Department. Inquiries regarding the 327-page illustrated publication should be sent to the Dean of Engineering, Purdue University, Lafayette, Ind.

Relief Wells. Results of an investigation, employing sand models, of the phenomena of underseepage and the use of pressure relief wells as a means of controlling underseepage and sand boils along the lower Mississippi River levees are detailed in Technical Memorandum No. 3-304, recently issued by the Waterways Experiment Station at Vicksburg, Miss. The publication, which is entitled *Relief Well Systems for Dams and Levees on Pervious Foundations*, sells for $1 a copy upon application to the Station.

Engineering Drawing. The importance of engineering drawing to the engineer; advances in engineering drawing practice; drawing for reproduction; trends in the dimensioning of engineering drawings; and articles on numerous other phases of the subject comprise the December 1949 issue of the Ohio State University *Engineering Experiment Station News*. Contributors are the alumni and faculty of the university and authors of some of the papers presented before the 1949 mid-winter meeting of the Engineering Drawing Division of the ASEE. Single copies may be obtained free of charge from the Engineering Experiment Station at OSU, Columbus, Ohio.

Personnel Survey. The Industrial Relations Section of the California Institute of Technology has recently issued a comprehensive survey of personnel practices in Los Angeles County for the benefit of employers. Designated Bulletin No. 17, the present study is second in a series of industrial surveys being made by the Institute. Copies, priced at $2.50, are available at the Bookstore of the California Institute of Technology, Pasadena 4, Calif. A complementary study dealing with personnel practices of large employers in Los Angeles County, also released by the Industrial Relations Section, sells for $1 at the Caltech Bookstore.

Timber Preservation. A new format and larger page size have been adopted by the American Wood Preservers' Association for its 1949 *Proceedings*. The 600-page volume includes all papers and discussions presented at the 1949 annual meeting of the organization; wood preservation statistics for 1948, collected and compiled by Dr. Henry B. Steer, of the U.S. Forest Service; and a listing of the wood treatment plants in the United States. Copies of the *Proceedings* may be purchased from the headquarters office of the A.W.P.A., 839 Seventeenth Street, N.W., Washington, D.C., at $15 each.

Soil Research. Papers on agricultural soil maps, presented at the 28th annual meeting of the Highway Research Board, comprise Bulletin No. 22 of the Board. Included are "Use of Agricultural Soil Maps in Making Soil Surveys" by L. D. Hicks, chief soils engineer for the North Carolina State Highways and Public Works Commission; "Significance of the soil Survey Report in the Selection and Preliminary Assessment of Sites for Airplane Landing Strips" by Geoffrey B. Bodman, professor of soil physics, University of California; and a tabulation showing present status of agricultural soil mapping in the United States. The bulletin may be purchased from the Highway Research Board, National Research Council, Washington 25, D.C., for $1.80.

Snow Surveys. Cooperative snow investigations, made in the upper Columbia River area in the 1947–1948 water year by the Army Corps of Engineers, the Department of Commerce, and the U.S. Weather Bureau, are detailed in Technical Report No. 20-1, recently issued by the Corps of Engineers. Entitled *Hydrometeorological Log of the Upper Columbia Snow Laboratory*, the report is available from the Program Director, Cooperative Snow Investigations, Corps of Engineers, Oakland Army Base, Oakland 14, Calif.

Structural Fatigue. Investigations of the fatigue strength of various materials used for the repair of bridge members are reported by Wilbur M. Wilson, Hon. M. ASCE, and W. H. Munse, Jun. ASCE, of the University of Illinois research staff, in Bulletin Series No. 382 of the University's Engineering Experiment Station. The tests described were conducted, under Professor Wilson's direction, by the Engineering Experiment Station in cooperation with the U.S. Bureau of Public Roads, the Chicago Bridge and Iron Co., the Association of American Railroads, and the Bureau of Ships of the Navy Department. Copies of the bulletin may be purchased from the Engineering Experiment Station at the University of Illinois, Urbana, Ill.

Technical Lettering. A short comprehensive course in technical lettering has been made available in a recent publication entitled *Technical Lettering Practice* by Henry C. Spencer and Hiram E. Grant. Though the letters are the same as the American Standard lettering (ASA Z14.1-1946), they are considerably more refined in detail. The order of strokes and the proportions of the letters have been thoroughly restudied by the authors with the aim of simplification. The volume may be purchased for $1.35 from the Macmillan Co., 60 Fifth Avenue, New York 11, N.Y.

Snow and Ice Control. Results of a two-year program of research in control of snow and ice in cities under 200,000 conducted by the Committee on Street Cleaning and Snow Removal of the American Public Works Association, are outlined in Special Report No. 10, which is currently available. Copies, priced at $2, may be obtained from the APWA, 1313 East 60th Street, Chicago 37, Ill. A discount of 40 per cent is available to APWA members.

Concrete. A fifth edition of the Bureau of Reclamation's *Concrete Manual*, prepared by its Design and Construction Branch, is now available, at $1.75 a copy, from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., or the Bureau of Reclamation, Denver, Colo. The 489-page, pocket-size manual incorporates recent construction advances and techniques, including instructions on the use of air entrainment; data on the occurrence and use of pozzolans and their effect on concrete; new information on the occurrence of alkali-aggregate reaction in concrete and on preventing concrete deterioration; and new procedures for concrete repair.

Highway Economics. Current highway needs of the country, assembled as a result of inquiries sent last summer to governors and highway departments of all the states, are outlined in a public print of the Joint Committee on the Economic Report, entitled *Highways and the Nation's Economy*. According to the report, correcting the deficiencies of the present state highway system alone will require an expenditure of $23,044,630,320, and an additional $10,400,000,000 will be needed to bring county and local rural roads up to present-day requirements. Copies of the print are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

(*Continued on page 86*)

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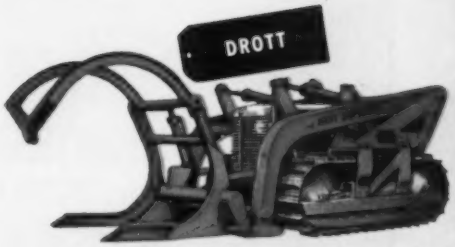

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CIVIL ENGINEER; Jun. ASCE; 31; married; B.S. in C.E., February 1950, University of Illinois; 4 years' experience as marine and steel window draftsman. Desires work with contracting firm. Available immediately. C-573.

CIVIL AND HYDRAULIC ENGINEER; M. ASCE; 49; Chinese; Ph.D., 1926, Cornell University; 25 years' experience as designing engineer, professor, dean of engineering, chief engineer, executive member of river commission; both American and Chinese experience. Specialization: hydraulic, structural, and railroad engineering. Location desired United States. C-574.

STRUCTURAL ENGINEER; Assoc. M. ASCE; 31; college graduate with advanced degrees; 5 years' experience in design with consulting engineering firm. Interested in teaching structure theory and design, or research work in the field of structural engineering. C-575.

CIVIL ENGINEER; Jun. ASCE; married; B.S., Washington State University; M.S., University of Illinois; 4 years' experience in reinforced concrete building construction in South America. Desires similar employment preferably with construction contractor prefers Middle West. C-576.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

CIVIL ENGINEER; Jun. ASCE; 27; married; veteran; B.S. in C.E., January 1949; 1 year and 4 months drafting room and shop experience in structural steel. Fluent in Italian, knowledge of French and Spanish. Desires position as sales engineer or field engineer. Domestic or foreign service optional. C-577

HYDRAULIC ENGINEER-HYDROLOGIST; Jun. ASCE; married; veteran; M.S. in C.E., Massachusetts Institute of Technology; 5 years' experience military weather forecasting, 2 years' river forecasting and hydrologic investigations. Desires position in meteorological-hydrologic investigations leading to hydraulic design. Prefers East or Midwest; travel occasionally. C-578.

CIVIL ENGINEER; Jun. ASCE; 27; married; B.S., M.S. in C.E.; 2 years' experience refinery construction, varied experience on welded structures; a year as overseas aircraft maintenance school director in Armed Forces. Desires college teaching position for fall term. Desires Kansas, Midwest, or Southwest. C-579-264.

CIVIL ENGINEER; Assoc. M. ASCE; 43; married; professional engineer license, West Virginia and Kentucky; graduate engineer; 18 years' experience heavy construction, railroads; presently employed with large eastern railroad but would like to enter another field in which experience is of benefit; will consider any location in continental U.S. Available on 2 weeks' notice. C-580.

CIVIL ENGINEER; Student M. ASCE; 25; single; veteran; bachelor's degree of civil engineering with structures option from Rensselaer Polytechnic Institute, June 1950. Desires career with a construction company or consulting office. Willing to travel stateside or foreign. Available in July. C-581.

CIVIL ENGINEER; Jun. ASCE; graduate; married; veteran; 3 years' experience with contracting and engineering firms. Desires position with a contractor in capacity of junior engineer doing either field or office work. Prefers Mid-west location. C-582-263C.

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CIVIL ENGINEER, 30–45, experienced in the design and construction of sewer and water systems, street improvements, and other municipal improvements. Must be free to travel. Salary, about $7,000 a year. Headquarters, St. Louis, Mo. Y-3160-R-6278.

CONSTRUCTION ENGINEERS over 40, for irrigation and allied work. Experience desired in drainage and reclamation, water supply and flood protection, and hydroelectric and harbor engineering. Some administrative experience desirable. Three-year contract. Salary, $1,500 pounds sterling a year. Location, Ceylon. Y-3192.

PORT ENGINEER, 35–50, experienced in design and layout of waterfront structures. Some knowledge of Spanish or French desirable. Salary open. Location, New York, N.Y. Y-3302.

TEACHING PERSONNEL. (*a*) Assistant or Associate Professor in civil engineering, with at least a master's degree and some experience either in practice or teaching in the fields of structural engineering and/or applied mechanics, to teach at both the undergraduate and graduate levels, and do some research in either or both fields. Salary open. (*b*) Instructor in civil engineering, preferably with master's degree, to teach elementary courses in structural engineering and applied mechanics. Salary open. (*c*) Graduate Assistant in civil engineering in the fields of fluid mechanics, sanitary engineering, and structural engineering. Half time will be spent on research and half time on graduate work, making it possible to secure master's degree in 2 years. Appointments for 9 months. Positions available in the fall semester 1950. Location, New England. Y-3327-R-6285.

ENGINEERS. (*a*) Civil Engineer, party chief for pipeline location. Experience in pipeline location and construction, or other route surveys and land surveys. Free to travel, furnish own car and equipment. Prefer engineer with his own practice who is free to accept temporary work of this nature. (*b*) Civil Engineer, to head structural section for consulting engineer's office. Some experience in municipal work desirable, but not necessary. Salary open. Location, South. Y-3336C.

ENGINEERS. (*a*) Design and Layout, 6–8 years' experience with conveyors, screens, crushers, and other equipment for handling bulk materials encountered in galleries and processing of coal, steel, coke, ore, etc. Should be able to do some steel detailing in connection with structures which include sheet steel sheathing. (*b*) Structural Engineer, graduate, with Illinois structural engineer's license, substantial experience with concrete and steel (heavy foundations, large and heavy tunnels, and industrial steel), to support heavy conveying and bulk materials processing equipment. Must be good enough to act as keyman and help draftsmen, detailers, and other designers. Location, Illinois. R-6079.

SPECIFICATION REPORTS ENGINEER, over 10 years' experience civil engineering field work or general office engineering on hydroelectric powerhouse construction. Must have knowledge of heavy excavations, cofferdams, large concrete work, heavy blasting adjacent to installed work as encountered on dam and spillway construction. Should be able to review mechanical, electrical, structural, and civil engineering specifications, and prepare properly assembled reports dealing with such heavy construction. Salary, $6,000 a year. Location, Illinois. R-6190.

DESIGNERS (sewers), C.E. or equivalent; up to 60; 5 years' or more experience acceptable; knowledge of drainage areas, sewer sizes and methods of calculating, and determining required. Will make calculations, prepare engineering data on intercepting and storm sewer reliefs. Some drafting. Salary, $4,800 plus vacation and other benefits. Location, Indiana. R-6216.

ENGINEERS. (*a*) Chief of Engineering Division. Must be especially good in construction of asphalt pavement, curbs and gutters, storm drains, and sidewalks. Should be a good locating engineer and have at least 5 years' experience in subdivision work. Salary, $5,600–$7,500 a year. (*b*) Chief Construction Engineer, to be in charge of all inspectors of work as outlined above. Must have at least 3 years' experience in subdivision work, one of which was in responsible charge. Salary, $4,800–$5,760 a year. (*c*) Chief Design Engineer, to be in charge of the design department. Must be a top designer on subdivision work as outlined above and be able to assume responsibility of all work in the design department. Should be able to serve as locating engineer if necessary. Salary, $4,800–$5,760 a year. (*d*) Design Engineers.

(*Continued on page 86*)

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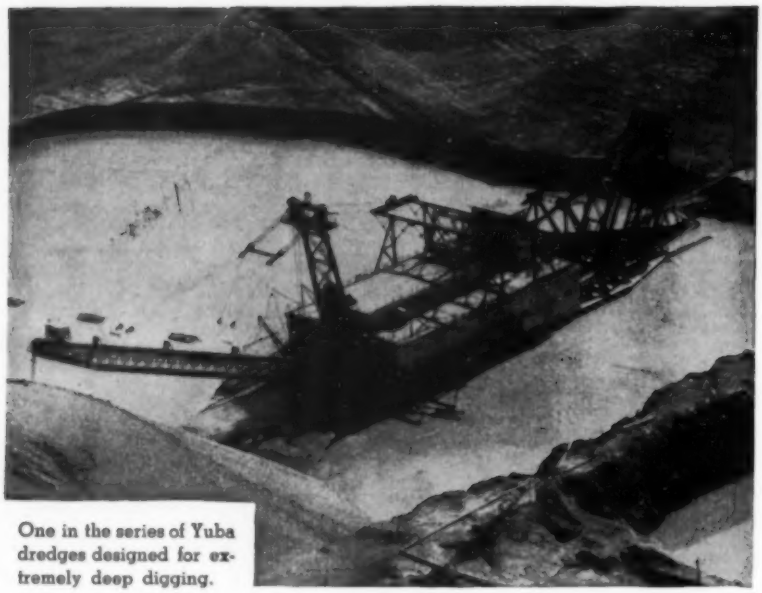

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(*Continued from page 85*)

Must be able to direct draftsmen who will be working under him. Should have had not less than 3 years' experience in this type of design work. Salary, $4,000–$5,280 a year. Location, East. Y-3218.

CITY MANAGER, 30–45, with extensive experience in municipal engineering, city planning, public works. Must be a good administrator. Knowledge of Hebrew desirable. Salary, $7,000–$10,000 a year. Location, foreign. Y-3237.

ENGINEERS. (*a*) Structural Designer, 35–50, civil graduate, with at least 5 years' design experience in industrial type buildings, to design structural steel, reinforced concrete and foundations. Y-3252.

SANITARY AND HYDRAULIC ENGINEER with at least 10 years' experience in the designing of sewage and water systems, sewage-treatment plants, water-treatment plants, reservoirs, dams, and miscellaneous sanitary and hydraulic municipal projects. Work also includes investigations, studies, and reports for consulting firm. Location, Massachusetts. Y-3279.

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RECENT GRADUATE, C.E.; around 30; to conduct research and product development in connection with concrete block manufacturing. Salary open. Location, Illinois. R-6281.

DESIGNER, C.E.; 35 up; 10 years' experience with sewers, paving streets, roads, parking areas, etc. Able to draft, design, and write specifications with minimum supervision. Requires 2–5 years' field experience plus 5 years' or more drafting room experience. Salary, $450–$550 a month. Location, Illinois. R-6288.

TEACHING PERSONNEL. (*b*) Associate or Full Professor, civil engineering, specializing in sanitary engineering, preferably with a doctor's degree. Salary, $5,000–$6,000 on 9-month basis. (*c*) Assistant Professor of civil engineering to teach surveying, analytical mechanics, and strength of materials; preferably with M.S. degree. Starting salary, about $4,000–$4,500 on 9-month basis. Location, West. R-6300.

DESIGNER (structural) C.E., up to 45; minimum 5 years' experience on structural design (buildings, elevated, surface, and underground structures); able to prepare estimates, take-off materials, order materials and supervise installations. Will prepare drawings, make computations, prepare estimates, expedite and engage in office and field work. Salary, approximately $450 a month, plus extensive benefits. Location, Chicago, Ill. R-6304.

DESIGNER, C.E., extensive and important experience designing steel and reinforced concrete, building structures, etc. Must be able to operate independently. Salary open. Location, Chicago, Ill. R-6309.

New Publications

(*Continued from page 82*)

Engineering, Palestine. Among engineering contributors to the current *Technion Yearbook*, publication of the American Technion Society, are Philip Sporn, M. ASCE, utilities executive, who writes on "Prospects in Industrial Application of Atomic Energy"; A. E. Barrekette and Jacob Feld, Members ASCE, who discuss the Jordan Valley Authority Irrigation Project; Joseph D. Lewin, M. ASCE, whose subject is "Protection of Dams Against Aerial Attack"; and many others. Inquiries concerning this 256-page handsomely illustrated publication should be addressed to the American Technion Society, 154 Nassau Street, New York 7, N.Y.

(*Continued on page 88*)

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ON DORR CLARIFIER MAINTENANCE COSTS!

REPAIR COSTS ON DORR TYPE S (ROUND) CLARIFIERS

SIZE	PURCHASE PERIOD	YEARS IN SERVICE	NUMBER OF UNITS	REPAIR COSTS		REPAIR COST AS % OF ORIGINAL COST
				TOTAL	PER UNIT	
100'-200' Dia.	1931-42	4-15	115	$3,568	$31	0.27
Under 100' Dia.	1932-33	13-14	30	812	27	1.00
Under 100' Dia.	1934-35	11-12	65	2,121	33	0.71

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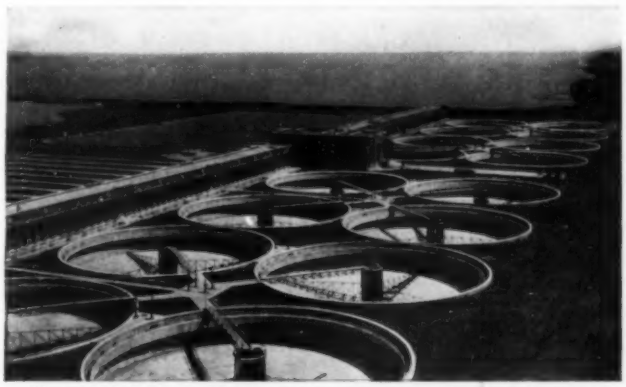

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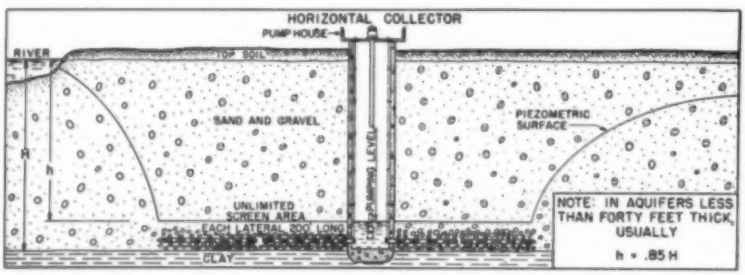

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(*Continued from page 86*)

Surveying. To aid engineers in the field in adjusting surveying transits and wye, dumpy and precision tilting levels, two new pocket-size booklets have been released by W. & L. E. Gurley. Adjustments of transits, suggestions on care and maintenance, and causes of mechanical and instrumental errors and their correction are included in Service Booklet "A," while Booklet "B" contains similar information on levels. Free copies are obtainable from W. & L. E. Gurley, Troy, N.Y.

House Maintenance and Repair. Up-to-date information on the repair and maintenance of houses, based on the results of almost 50 years of research and testing, is made available in Circular 489 of the National Bureau of Standards. The 209-page illustrated publication, entitled *Care and Repair of the House*, may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., at 50 cents a copy.

UNESCO. An informal report on UNESCO and the U.S. National Commission for UNESCO is available in a new publication, entitled "UNESCO Today," issued by the Department of State in response to numerous requests for specific information. The first section emphasizes international aspects of the organization, and the second deals with the accomplishments of UNESCO in the United States through the U.S. National Commission. Teachers, organization leaders, and school officials may obtain free copies, upon application to the UNESCO Relations Staff, Department of State, Washington 25, D.C. Copies are on sale to the general public from the Superintendent of Documents, Washington 25, D.C., at 10 cents a copy.

Proceedings Papers Available as Separates

(*Continued from page 57*)

graphs. Comparisons with hypothetical "fixed rule" and "ideal" operations are made to determine the efficiency of the actual operations. The paper also discusses the effect of tributary reservoirs and main-river reservoirs considered as groups. (Available June 1.)

20. Three-Dimensional Displacement Diagrams for Space Frame Structures by Walter Worthington Ewell, Jun. ASCE. The Williot-Mohr displacement diagram is an invaluable aid in the analysis of planar structures—yielding intrinsically important joint displacements, facilitating the construction of influence lines for redundant elements, and simplifying the calculations of secondary stresses in trusses. The space displacement diagram developed in this paper determines the movements of space frame joints along the three coordinate axes of space and lends itself to applications similar to those realized with the planar Williot-Mohr diagram. Three-dimensional displacement diagrams are presented for a simple space pedestal and for a second-degree indeterminate space truss. The graphical examples are illustrated progressively in three separate phases to clarify all construction principles, including the use of a rotational correction diagram. (Available June 1.)

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3 AIR INLET VALVES

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4 ASPHALT CONSTRUCTION

The Texas Company—Step-by-step descriptions of the various types of asphalt construction and maintenance for streets, highways and airports are offered by two booklets. One of these publications is entitled "Road Building with Texaco Asphalt by the Pressure Distributor Method." The other is devoted to "Texaco Asphalt Paving—Plant-mixed Types." Useful tables for the road builder and instructions for unloading asphalt products from railroad tank cars are included in this literature, which is offered to interested persons without charge.

5 AUTOMATIC LINE OILER

Gardner-Denver Company—Information is available on a line oiler that protects against operating rock drills or other air-actuated equipment, without adequate lubrication. Known as the L012 automatic line oiler, this device shuts off the line air automatically when all the oil in the reservoir has been used.

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8 CAST IRON PIPE

Cast Iron Pipe Research Assoc.—An 87-page manual of mechanical joint cast iron pipe and fittings, while issued primarily for the gas industry, contains complete data on classes 150 and 250 pipe and all fittings, increasingly used in water works construction.

9 1950 CATALOG BOOKS

McGraw-Hill Book Co.—Here is a guide to practical, expert information on many business and technical subjects. This catalog contains clear, concise descriptions of more than 2,000 books written by leaders of business, industry and research. Get your copy now. In it you will find an up-to-date listing of books that give you the facts—experience—data—you need in solving your particular problems.

10 CEMENT GUN

Cement Gun Company, Inc.—Of considerable interest to the engineering profession is a 65-page booklet, designated as Bulletin 2400, describing the cement gun and its applications. It covers the principal uses of "Gunite" and is profusely illustrated. In the last few pages of this bulletin are typical specifications for various types of "Gunite" work.

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American Concrete Pipe Association—An official publication has just been released and is available to engineers. Contains information on design of irrigation pipe lines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 70¢.

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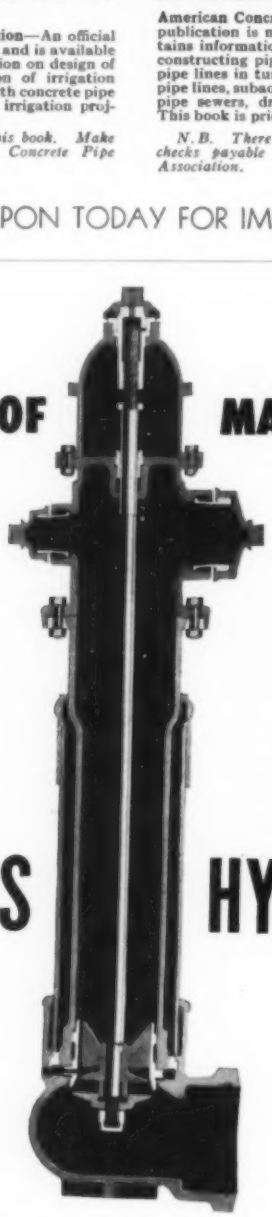

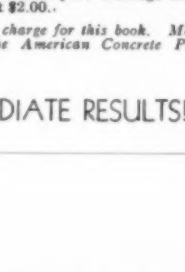

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20 CONCRETE VIBRATORS

Chicago Pneumatic Tool Co.—Bulletin 814 opens with a discussion on vibrator selection, design development, construction advantages and care of equipment. Sectional views, applications, features and specifications for pneumatic vibrators for reinforced concrete, as well as pneumatic and electric vibrators for mass concrete are covered.

21 CONTROLLERS AND LAYOUTS

Simplex Valve & Meter Company—Bulletin 250 gives dimensional data on horizontal and vertical type controllers and clearance layouts for these units when using different type close-off arrangements. Type "S" rate controller for use in effluent lines from rapid sand type filters. This bulletin is of essential interest to the filter plant designing engineer.

22 CORE DRILLING MACHINE

Sprague & Henwood, Inc.—Bulletin No. 185 describes in detail Model 40-C, a core drilling machine. The outstanding construction features of this new unit are clearly presented and ample pictures enable the reader to understand better the combinations of power units and swivelheads that are available.

23 CORE DRILLING MACHINES

Sprague & Henwood, Inc.—Bulletin No. 305 describes four of the more popular models of core drilling machines. This publication furnishes a brief description of the various machines and emphasizes the outstanding features of each. Capacities are shown for each drill when using the various sizes of standard diamond drill accessories available.

24 CORE DRILLING MACHINES

Sprague & Henwood, Inc.—Bulletins which describe the various core drilling machines in detail, accessory equipment Bulletin No. 31-F, diamond bit Bulletin No. 44-A, and several others are compiled in a general catalog that is now available for distribution.

25 CORR-PLATE STEEL PILING

Caine Corr-Plate Piling Co.—Complete description, specifications and photographs of typical installations are included in a new catalog. Corr-plate steel piling is the strongest piling per lb weight; cold rolled from open hearth steel; economical, light in weight; easy to handle, easy to drive and pull, and easy to transport (nestable). Can be used over and over again. Available in standard and inter-locking sections. Used widely in excavation and construction of foundations, dams, retaining walls, docks, levees, bulkheads, sewers, disposal plants, etc.

26 CRAWLER TRACTOR

Allis-Chalmers Mfg. Co.—An attractive 24-page catalog featuring the HD-5 crawler has been released. Photographs and cutaway views illustrate the "5's" track release mechanism, positive sealed truck wheels, and other features which simplify maintenance problems and assure longer life.

27 CRAWLER TRACTOR

International Harvester Co.—New features of the increased-horsepower International TD-9 Diesel crawler tractor are described and illustrated in an attractive 2-color mailing folder, designated as Form No. A-351-NN. Design changes incorporated in current production models of the International "9" series 4-cylinder engine have raised the tractor's work capacity by increasing the hp at the flywheel and drawbar. Full details are included in the new mailer.

28 CRAWLER TRACTORS

International Harvester Co.—Three new, attractive, profusely illustrated, 24-page catalogs describe the new International diesel crawler tractors—A-153-MM, the TD-24 of 140 drawbar hp; A-179-MM, the TD-18A of 87 drawbar hp; A-178-MM, the TD-14A 60.5 drawbar hp. Mechanical features and complete specifications are presented.

Please remember industrial literature is costly. It is requested that you ask only for those booklets of particular interest to you.

29 CRUSHING AND SCREENING PLANTS

Austin-Western Company—Bulletin No. 1999 describes the latest Austin-Western two-unit and three-unit portable crushing and screening plants which have been developed for either pit or quarry use. How these plants are capable of delivering high tonnages of aggregate in accurately controlled sizes; and how the three units (primary breaker, primary and secondary) may be used separately or in combination, as desired, providing flexibility of operation, is contained in the bulletin.

30 DESIGN OF CONCRETE MIXES

Portland Cement Association—An attractive 70-page booklet gives detailed information on the design and control of concrete mixes. A few of the well-covered topics are fundamental facts about concrete and other materials. It covers mixing, handling and transporting, curing and protection and special types of concrete. These subjects are illustrated with pictures, charts, and diagrams. The Appendix contains specifications and tests of interest to contractors. This booklet is free, but is distributed only in the United States and Canada.

31 DIATOMITE FILTER

Permutit Co.—Bulletin 3415 describes the operation and advantages of the diatomite filter which requires less space, saves cost of coagulants and saves in amount of backwash water. The improved type of filter element is completely rigid, resistant to corrosion and lacks wires or screens which may be easily damaged or clogged.

32 DIESEL TRACTOR

Caterpillar Tractor Co.—A 29-page illustrated booklet, Form 12676, entitled "Caterpillar" D8 Diesel Tractor, has been released. Featured in the booklet is the D8's ability to get things done effectively, efficiently, and with a minimum of "time out" for maintenance and repair. Quality features of this Diesel track-type tractor are discussed and illustrated along with complete specifications.

33 DIGESTER

The Dorr Company—A 4-page booklet describes in detail The Dorr Type MA Digester designed to combine single-stage digestion, high capacity mixing and gas storage. The leaflet contains a brief description with photographs and drawings of the digester, along with a summary of the advantages derived from its use.

34 DOORS, STEEL ROLLING

Kinnear Manufacturing Company—The advantages, the economy, the construction features, and the general specifications of the various types of Kinnear wood and steel upward-acting type doors are fully discussed and illustrated in a new catalog and data book just published. Known as Bulletin 63, it gives information on insulation clearance requirements, methods of operations and controls, as well as the adaptability of the doors for many types of uses.

35 DRAFTING MACHINE

Keuffel & Esser Co.—A booklet explains and illustrates the construction and time-saving operation of the Paragon drafting machine, which combines the function of T-square or straightedge, triangles, protractor, and scales into one unit easily controlled by the left hand alone, leaving the right hand free for drawing.

36 DRAFTING SUPPLIES

Berger Scientific Supplies, Inc.—will furnish upon request its well illustrated Catalog "A" describing a complete line of drawing instruments, slide rules, T squares, curves, triangles, scales and other equipment for architects, engineers and draftsmen.

37 DRAWING PENCIL

Eagle Pencil Co.—Will furnish a free sample of their Eagle Turquoise drawing pencil in any degree of hardness requested.

38 DRY CHEMICAL FEEDER

Permutit Co.—Bulletin 3156 outlines the principles and design of the dry chemical feeder. The advantages of this type of feeder are: extreme accuracy, wide feeding range, stepless adjustment of dosage, reproducibility of feeding rate for any feeder setting, adaptability to either acid or alkaline chemicals.

Order Your Literature Now by mailing the coupon on page 90 to CIVIL ENGINEERING.

39 DURAPLASTIC CEMENT

Universal Atlas Cement Co.—A 20-page, 2-color commemorative booklet entitled, "A Decade of Atlas Duraplastic" traces the 1939–49 period of the origin, development and remarkable use-acceptance by the construction industry of Duraplastic air-entraining cement. With accent on pictorial-testimonial presentation, the booklet describes how Duraplastic was developed originally to solve the problem of concrete pavement scaling due to the use of de-icing salts; how it succeeded in this objective, from 1939 on.

Prompt return of your coupon will bring your literature to you sooner.

40 EFFECTS OF CALCIUM CHLORIDE

Solvay Sales Div., Allied Chemical & Dye Corp.—has prepared a 40-page semi-technical booklet, of interest to architects, engineers and others concerned with specifications, design or production of Portland cement concrete. This booklet contains tables, graphs and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage, and ultimate strength. Also shown are effects of varying temperatures and cold weather, and the results with special cements including air entraining, high early strength and low heat cements.

41 ELECTRIC SHOVEL

Harnischfeger Corp.—Leading the field in electric shovel developments, P & H's "Magnetorque" hoist drive, "Magnetron" control, independent propel, air-filtered cab, positive steering and the many other outstanding features of P & H diesel electric and full electric shovels are fully described and illustrated in Bulletin X 83-1.

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NOW . . . Available by Number in Standard Sizes of New A.S.T.M. Serial Designation A305-49 Table I

Thanks to A. S. T. M. specification A305-49, designers now have a more efficient bar for concrete reinforcement . . . one that provides **increased anchorage** which when properly used will give appreciable **savings in steel and concrete.** Advanced design Laclede Multi-Rib Reinforcing Bars exceed the A305-49 specification. They are available in uniform round sections in all standard sizes and can now be ordered by number.

TABLE I A.S.T.M. SERIAL DESIGNATION A305-49

Dimensional Requirements for Deformed Steel Bars for Concrete Reinforcement

		NOMINAL DIMENSIONS ROUND SECTIONS			REQUIREMENTS OF DEFORMATIONS		
Bar No.°	Unit Wt. Lbs./Ft.	Diameter-Inches Decimal	Cross Sectional Area Sq. Inches	Perimeter	Max. Avg. Spacing Inches	Min. Height Inches	Max. Gap. Inches ‡
3	0.376	.375	0.11	1.178	0.262	0.015	0.143
4	0.668	.500	0.20	1.571	0.350	0.020	0.191
5	1.043	.625	0.31	1.963	0.437	0.028	0.239
6	1.502	.750	0.44	2.356	0.525	0.038	0.286
7	2.044	.875	0.60	2.749	0.612	0.044	0.334
8	2.670	1.000	0.79	3.142	0.700	0.050	0.383
9*	3.400	1.128	1.00	3.544	0.790	0.056	0.431
10*	4.303	1.270	1.27	3.990	0.889	0.064	0.487
11*	5.313	1.410	1.56	4.430	0.987	0.071	0.540

*These sections have the same weight and area as bars formerly known as 1" Sq., 1⅛" Sq. and 1¼" Sq.

‡Chord of 12½% of Nom. Perimeter.

°Bar numbers are based on number of ⅛" included in the nominal diameter of the bar section.

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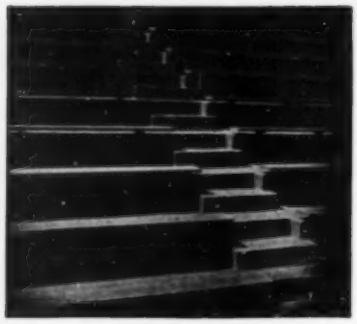

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CATALOG DIGESTS

42 ELEVATED WATER TANKS

Chicago Bridge & Iron Co.—has recently revised its 20-page booklet describing the advantages of using elevated steel tanks to provide gravity pressure in municipal water works systems and in private systems supplying water for general service and fire protection at industrial plants. The booklet entitled "Horton Ellipsoidal-Bottom Elevated Steel Tanks of Welded Construction" contains illustrations of 7 elevated water tanks of various sizes; a table of standard capacities; and a page of drawings showing construction details.

43 ENGINEERING INSTRUMENTS

W. & L. E. Gurley—An illustrated 64-page catalog, No. 50, describes the complete line of Gurley engineering instruments. Description and specifications of several types of transits, levels, alidades, leveling and stadia rods, and plane tables with accessories is listed. Dip needle, cruising and geologists compasses are included.

44 FACILITIES & PRODUCTS

Newport News Shipbuilding & Dry Dock Co.—Illustrations on everyone of the 40-pages of this attractive book show some of the company's facilities and products in the process of manufacture. A wide range of facilities as to function, type, and capacity, together with a trained organization, are needed for the building of large compact vessels, producing rayon-yarn-spinning machinery, steel pipe lines, tanks, valves, gates, and a variety of equipment designed especially by the user. The company has long been preeminent in the manufacture of hydraulic turbines with installations throughout the world.

45 FEEDER FOR DRY MATERIALS

Omega Machine Co.—Bulletin 20-23 describes a loss-in-weight type gravimetric feeder which handles almost any granular or powdered material, including lumps to 1¼ in. The feeder weighs, feeds, and records with an accuracy of 99% or better. Bulletin shows operating mechanism and auxiliary equipment, lists materials fed, and gives data for proportional control.

46 FILTER GAUGES

Simplex Valve & Meter Co.—A complete description of the standard forms of filter plant gauges are offered in Bulletin No. 1,000. These gauges cover the new streamlined design utilizing circular rate of flow and loss of head chart and circular indicating dials. It is illustrated with photographs and dimension drawings showing methods of mountings of filter rate, loss, sand expansion, elevation and large dial wash water gauges.

47 FOOTWALKS

Wm. F. Klemp Co.—offers its 1949 edition of their catalog entitled "Klemp Open Steel Grating and Stair Treads, the Perfect Structural Steel Flooring," containing information on riveted and welded grating, structural steel footwalks, bridge decking and drain grating, for use in refineries, power houses, sewerage units, mezzanine storage rooms, catwalks, heavy industries, bridges, etc. Fully illustrated, the book includes a safe-load table, and complete engineering data.

48 FOUNDATIONS

Drilled-In Caisson Corporation—Literature describes foundation columns anchored in rock sockets; heavy column loads carried on single caissons; penetration through any type of soil to rock at any depth; examination of rock can be made; economy in time and labor; foundation bonded in rock; description, design, specifications, technical data.

49 FOUNDATIONS AND HEAVY CONSTRUCTION

Spencer, White & Prentis, Inc.—Literature on the construction of difficult and unusual foundations; description of concrete-filled steel tubes driven to rock, including technical data, performance and installation, description of Pretest Underpinning and the application of the Pretest Method to construction other than foundations; Pretest foundations; caissons; foundations under existing buildings; shoring and moving buildings.

50 FOUNDATIONS AND SOIL BORINGS

MacArthur Concrete Pile Corp.—A booklet giving concise data on pile foundations describes cast-in-place, composite, steel, sectional pipe, timber and H piles. Also given are notes on soil and rock exploration, and pile driving problems with special notes and engineering information covering 40 years' experience installing cast-in-place concrete piles.

CATALOG DIGESTS

51 FOUNDATIONS AND UNDERPINNING

Underpinning & Foundation Co., Inc.—Of special interest to engineers is literature describing steel pipe pile foundations and underpinning by pioneers who have specialized in this field; application, design and methods are included. The scope of this Company's work also includes open and pneumatic caissons, subway and tunnel construction, sinking of mine shafts, cofferdams, and all other types of substructures and heavy construction.

52 FRAME CONSTANTS

Portland Cement Association—A handbook of frame constants—especially useful in frame analysis—offers tabulations of fixed end moments, and stiffness and carry-over factors for members with parabolic and straight haunches. This offer is free, but is distributed only in the United States and Canada.

53 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Catalog F-225 contains illustrations, descriptions and engineering data on grating-flooring, treads and floor armoring (riveted, press-locked, welded types)—safe, durable, fireproof, ventilating, clean and economical—for industrial, power and refinery walkways, stairways, driveways, trucking aisles; ship cat-walks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring, expansion joints, catch basin covers; bridge decking.

54 GRID ROLLER

Hyster Co.—A grid roller consisting of two 5-ft diam wheels or rollers attached to a frame for towing behind a motor grader or tractor is fully covered in an 8-page booklet. The open mesh design of the grid surface results in a high degree of compaction in a minimum number of passes. The roller may also be used for salvaging and maintaining black-top pavement.

55 GUARDRAIL & BRIDGE RAIL

Armco Drainage & Metal Products, Inc.—A 16-page illustrated and informative booklet outlines the factors influencing guardrail design and points out how Flex-beam meets highway safety needs in a variety of service conditions. Photographs show actual installations. The special features of Flex-beam—high impact resistance, prevention of "pocketing," economy and adaptability—are discussed in detail. Also included are 8 pages of basic design data.

56 HAND LEVEL

Keuffel & Esser Co.—A booklet describes the precision-made hand level for speedy and convenient surveying. It also explains and illustrates how one man can use it for rough grading, locating contour lines, etc., and how he, with an assistant and a rod, can take cross section, set slope stakes, etc.

57 HEAVY DUTY EQUIPMENT

Caterpillar Tractor Co.—A complete package of heavy duty equipment that is "Caterpillar" powered, features the illustrated contents of a 16-page booklet, Form 12311, "Slope State to Final Grade with 'Caterpillar' Equipment." Presenting the reader with a detailed method of pioneering the land through the application of machines engineered and designed for low cost clearing, short haul work and initial cut performance, this booklet emphasizes its informative material with pictorially displayed projects.

58 HIGHWAY CONSTRUCTION

American Association of State Highway Officials—A 181-page manual of highway construction practices and methods, represents the combined judgment of highway engineers throughout the county. An adequate description of the nature of the work to be performed, the materials to be used, the objectives to be attained and the basic principles involved are included. A ready reference for construction personnel and an excellent textbook for students of highway engineering. Price $2.50 per copy, paper back edition.

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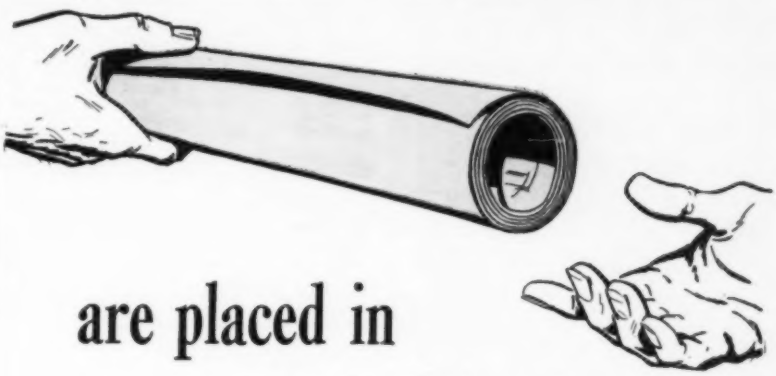

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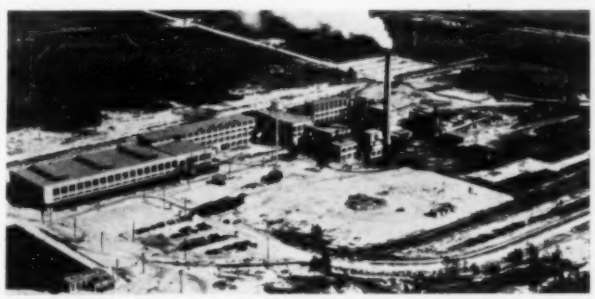

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CATALOG DIGESTS

59 H-PILES

Bethlehem Steel Co.—A valuable and worthwhile booklet to the construction engineer is Catalog 223. The book thoroughly covers the history, characteristics, test pile data, life of steel, designs of installations and general specifications of H-piles. Dimensions, diagrams, tables, formulas and pictures are included.

60 HYDRANTS AND GATE VALVES

R. D. Wood Co.—A 22-page booklet, "Mathews Modernized Hydrant," gives detailed description of its various features, with numerous photographs and sectional views to clarify the text. Appropriate space is devoted to the removable barrel, containing all the working parts, to the completely revolving head, and to the Sand-Spun protection case. A portion of this booklet is an illustrated treatment of gate valves that stay reliable under severe service conditions.

61 HYDROPEL

American Bitumuls Co.—An illustrated booklet describes Hydropel—an integral waterproofing admix of remarkable efficiency for concretes and mortars. It also protects concrete against alkaline salts and freeze or thaw actions. It improves workability and allows added flexure.

62 INFILTRATION COLLECTORS

Ranney Method Water Supplies, Inc.—A seventeen-page booklet, entitled "Industrial and Municipal Water," describes the basic principles involved in the design and construction of horizontal infiltration collectors. Included are a list of completed installations and reprints of several technical articles which summarize actual operating experience. Four diagrams and eight construction photographs illustrate the text of the booklet.

63 INTERMEDIATE PLANT

Barber-Greene Co.—This unusual piece of product literature points to a trend in road building. Valuable information on the development of a logical and economical road building and maintenance program is given. Consisting of eight 2-color pages, Bulletin 848 shows drawings and photographs of typical plant set-ups, pictures of operating plants, and important components of B-G units used in the production of low cost, long-lasting roads.

64 IRON-CLAD CONCRETE FLOOR

The Master Builders Co.—A 36-page illustrated booklet showing that the Masterplate floor, having an iron-armored surface about 1/8 in. thick, wears at least 5–6 times longer than a plain concrete floor. Discusses the additional features of spark resistance, easy-to-clean, color, static dissemination, non-dusting, corrosion resistance, non-slip and economy. Job pictures show typical installations. Booklet gives detailed directions for laying a Masterplate floor—for both new construction and resurfacing old floors.

65 KODAGRAPH REPRODUCTION

Eastman Kodak Co.—A new 20-page illustrated booklet describing features and advantages of Kodagraph papers, cloths, and film and their value in different types of drawing and document reproduction is offered. The photographic nature of these products, plus their suitability for use with present equipment, is emphasized.

66 LEROY LETTERING EQUIPMENT

Keuffel & Esser Co.—Leroy lettering equipment enables any draftsman to do perfect lettering with speed and ease. Fully illustrated, this booklet gives complete information on Leroy lettering sets, templates, scribers, pens and accessories. Leroy templates are available in a wide range of styles and sizes, including regular Gothic, reverse, condensed and outline Gothic, Cheltenham and Greek alphabets; electrical, welding, map and geological symbols and isometric drawing.

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CATALOG DIGESTS

67 MECHANICAL PIPE JOINTS

R. D. Wood Co.—A 4-page leaflet describing mechanical joints that meet the requirements for permanent tightness of pipe joints under conditions of deflection, expansion, contraction and vibration. They are designed for high-pressure lines for oil, gas, water, steam, or chemicals.

68 METERING WATER FLOWS

R. W. Sparling—Meters that can be completely installed and maintained on main lines by water department personnel are gaining ever-wider acceptance. Bulletin 310 illustrates the adaptability of the propeller-type meter for long service, accuracy, conservation of pressure, and simplicity of operation. Accuracy curves, installation suggestions, and details of instruments are given, with prices, etc.

69 METRIC WALL CHART

Mayo Tunnel Equipment Co.—A wall chart has been designed for the rapid conversion of meters to feet and inches. It is stated to be very valuable to engineers who must frequently convert meters to feet, or vice versa.

70 MIXED FLOW PUMPS

Economy Pumps, Inc.—Mixed Flow Volute Type Pumps are the subject of a new catalog No. F-1049. Designed for high speed transfer of liquids that may contain light solids, Mixed Flow Pump applications include sewage disposal, irrigation, raw water pumping, reduction, and similar pumping operations. The catalog features construction details, photographs, drawings, and a selection table covering applications of these Pumps of various sizes.

71 MODERN WATER PRE-TREATMENT

The Dorr Co.—A new 8-page, 2-color leaflet contains brief descriptions and photographs of all Dorr equipment available for water pre-treatment in the municipal and industrial fields. Also included in Bulletin 9141 are flow diagrams and a convenient table of basic design data for plant units treating various types of water.

72 MOTOR GRADER

Allis-Chalmers Mfg. Co.—A 6-page leaflet covering the 34.7 hp Model D motor grader has just been released. This 2-color bulletin introduces a new machine with several popularly accepted big grader features such as tandem rear-wheel drive, tubular frame design, and rear-mounted engine-transmission construction for improved visibility. A liberal amount of action pictures illustrate the "D's" ability to cope with low cost maintenance and light construction work.

73 MOTOR GRADERS

Caterpillar Tractor Co.—A 16-page booklet entitled "'Cat' Motor Graders Do the Job," designated as Form 12258, has been released. Illustrated with applications of precision ditching, bank shaping, general road maintenance, mixing road surfaces, terracing and snow removal, this publication offers performance records on coast-to-coast projects by these units.

74 MOTOR OIL

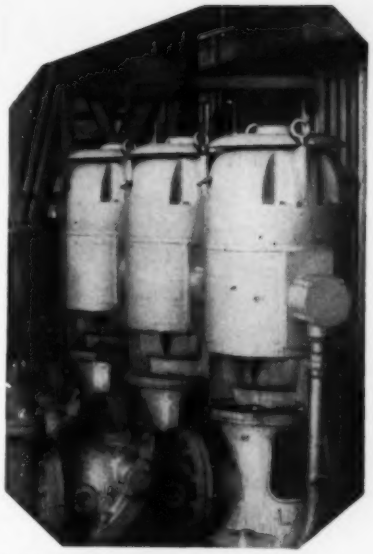
Standard Oil Co. (Indiana)—The booklet entitled "Stanolube HD Motor Oil" is a technical description and definition of heavy duty motor oils, illustrating through charts, photographs, and other data how Stanolube HD has demonstrated its ability to cope successfully with the most difficult problems of lubrication in automotive, diesel and H.D. engines.

75 NEW CONCRETE ERA

Lone Star Cement Corp.—40-page illustrated booklet summarizing facts disclosed by condition survey, after two decades in service, of the first highways, buildings and other structures in this country concreted with high early strength portland cement. Also contains factual information showing where the use of Incor 24-hr cement saves time and reduces construction costs.

76 NON-CLOG PUMPS

Economy Pumps, Inc.—Applications for vertical non-clog open shaft pumps include sewage disposal, flood control, reduction, drainage of liquid containing sand or silt, food pulp distribution, and use in paper mills for stock pumping, water supply, and overflow. Complete selection table included in catalog No. F-249.



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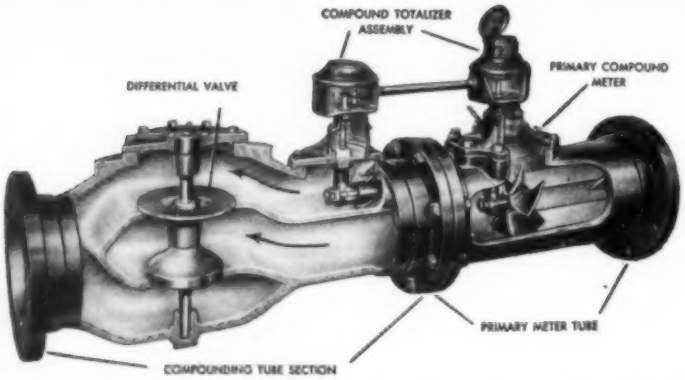
SPARLING MAIN-LINE METERS



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CATALOG DIGESTS

77 OPEN STEEL FLOORING

Kerlow Steel Flooring Co.—A 40-page catalog on open steel flooring for bridges contains latest engineering information on design and selection of grating and stringers. Catalog describes various designs and their applications for open flooring and filled slabs, with dimension charts, complete specifications, selection and installation data for each design.

78 PENCIL SKETCHING

American Lead Pencil Co.—24 pages of helpful illustrated instructions on pencil sketching. Only 25¢ with two free Venus drawing pencils.

N. B. There is a charge for this book. Make checks payable to the American Lead Pencil Co.

79 PILES AND CAISSONS

Western Foundation Corp.—Piles and caissons for every soil and condition of loading are described in a 12-page brochure. Featured are economical cast-in-place cylindrical piles with a large base that carry the structure load to dependable bearing strata at whatever depth it may be reached. Sketches in 4-colors show how button-bottom, pedestal, caisson and compressed concrete piles are cast-in-place.

80 PILE, TAPERED TUBULAR STEEL

The Union Metal Mfg. Co.—Descriptive information and engineering data on Monotube steel piles. The Monotube is a fluted, tubular steel pile, fully tapered or combining tapered and uniform sections. It is driven directly with standard pile-driving equipment without use of driving core or mandrel. Advantages listed: easy handling, speedy driving, economical field extendability, internal inspection after driving, high load-carrying capacity with consequent economy per ton of load carried.

81 PNEUMATIC GROUTER

Mayo Tunnel Equipment Co.—Bulletin No. 13 illustrates the Mayo pneumatic grouter. This is a very simple machine and since there are no moving parts within the grout, will last for years. While this machine has only a $3^1/_2$ cu ft capacity, it will place as much grout as the 10 cu ft "Mixer-Grouter."

82 POCKET TRANSIT

Wm. Ainsworth & Sons, Inc.—A booklet describing and outlining the use of the Brunton pocket transit and accessories is available. The booklet shows how horizontal and vertical angles can be determined to approximately one degree by using an instrument weighing only $8^1/_2$ ozs. This will be of interest to engineers who have occasion to make rough surveys, check grades and levels, or lay out roads or lines.

83 POWER GRADERS

Austin-Western Co.—A 24-page catalog AD-2112 pictures and describes the "88-H," the "99-H" and the Master "99" power graders with exclusive all-wheel drive and all-wheel steer. All types of work—rough grading, heavy ditching, scarifying, snow plowing, terracing and drainage, mixing, loading, rolling and bulldozing—are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

84 PRELIMINARY SURVEY PROCEDURE

American Paulin System—This booklet, available without charge to all civil engineers, is published in the interests of greater efficiency and economy of time and labor in the making of preliminary surveys under all conditions. The observer and author of this work, Raymond A. Hill, M. ASCE, explains in detail the practical use of the Paulin System Altimeter in connection with all branches of preliminary field surveying. Geologists, scientists, topographers, surveyors and educators will find this book of interest and technical value.

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CATALOG DIGESTS

85 PRESSURE-CREOSOTED PILES

Koppers Co.—A 16-page booklet designed to assist engineers in the evaluation of pressure-creosoted foundation piles for various types of construction projects has been issued. The booklet cites important national, regional, and city construction codes which allow pressure-creosoted wood foundation piles for permanent construction. Typical examples of the use of these piles are described and pictured.

86 RESTO-CRETE SYSTEM

Western Waterproofing Co.—"Maintenance and Restoration of Concrete Storage Tanks By the Resto-Crete System" is the title of a 4-page, 2-color booklet. Questions, such as, What causes damage to concrete masses? and How to recognize concrete deterioration are answered in detail.

87 RULING PENS

Keuffel & Esser Co.—Leaflet describes Marathon long line and wide line pens, which draw five to eight times more line between fillings than ordinary ruling pens. Five pre-set widths draw uniform lines from .009 to .060 in. width. Easy to handle for guided curve lines or freehand contour line work. Can be laid down filled without leaking.

88 SEWAGE & TRASH PUMP

Fairbanks, Morse & Co.—A 16-page 2-colored booklet is offered on the recently developed single passage bladeless impeller. Details of construction, principal dimensions, selection tables and performance characteristics, as well as typical specifications are thoroughly covered in Bulletin 5400K-1 on the vertical and horizontal shaft pumps.

89 SEWAGE REGULATORS

Brown & Brown, Inc.—Bulletin 81 with supplements A and B describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems either by cutting off such flows entirely during storm periods or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

90 SHOVEL FRONT

Hyster Co.—A new shovel front is the latest addition to the Hystaway, 1/2 yd tractor-mounted excavator which already provides a dragline, clamshell, crane and hoe as interchangeable features. Designed for D7 and D8 "Caterpillar" track-type tractors, the shovel mounts on either new or used machines, and utility use of a bulldozer on the rear of the tractor is possible even with the shovel in place. Specifications are available on Form No. 1130.

91 SIMPLEX EQUIPMENT

Simplex Valve & Meter Company—A general description of the complete line of Simplex equipment is offered in Bulletin 002. The bulletin describes and illustrates Venturi tubes, rectangular and circular chart type meters, controllers and gauges and methods of auxiliary close-off devices. It illustrates type "S" parabolic flume, W-K tap arrangements, manometers, pilot equipment, air inlet and air release valves.

92 SNOW PLOW-POWER GRADER

Austin-Western Co.—Bulletin AD-2092 describes the Sicard rotary snow master, used as an attachment with power graders. The advantages of 4-wheel drive and steer in connection with rotary snow plow operation are fully discussed and illustrated. The controllable wrist-action telescopic casting chute of the snow master is shown handling all types of snow removal including loading trucks from either side. This catalog describes and pictures snow removal under almost every condition both in opening and widening streets and highways. Brief specifications are also included.

93 SOIL SAMPLING EQUIPMENT

Sprague & Henwood, Inc.—The most complete publication on soil sampling equipment is found in Bulletin No. 75-A. Types of samples, value of samples and sample testing are described in this bulletin as well as equipment recommended for the taking of the actual sample in various formations.

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CATALOG DIGESTS

94 SOIL STABILIZER

Harnischfeger Corp.—A 4-page 2-color folder describes and profusely illustrates what P & H single pass soil stabilizers have accomplished on airport runways, highways and streets throughout Oklahoma, Nebraska, Kansas, Texas and many other states. A sectional view of the stabilizer along with condensed specifications is included.

95 SPEED-LAY PIPE SYSTEMS

Albert Pipe Supply Co., Inc.—A 5-page brochure describing "packaged" pipe line for temporary and semi-permanent air, gas and water lines is offered. This line is available in sizes 2 to 12 in., or larger if desired. It is lightweight, portable, easily assembled and available for prompt shipment. Includes pipe, couplings, fittings, adapters and valves where necessary.

96 SPIRAL HEAT EXCHANGER

The Dorr Co.—A 4-page, 2-color leaflet covering a method of heating sewage sludge digesters by external means is offered in Bulletin 6281. It contains photographs and a description of the equipment as well as operating results, design data, advantages and specifications.

97 STEEL BEARING PILES

Carnegie-Illinois Steel Corp.—A 100-page book presents comprehensive data and illustrations of the current practice in the design and use of the new steel CBP section bearing piles. In addition, there is an extensive review of the use of steel bearing pile sections, with records of tests of the past uses and applications.

98 STEEL DECK GRANDSTAND

Pittsburgh-Des Moines Steel Co.—offers a 24-page brochure describing their steel deck grandstand. It outlines the various features and advantages of this type of construction and describes the unit type of construction used, permitting ready enlargements of this type of grandstand when additional seating capacity becomes necessary. It includes 50 photographs of grandstand installations and a table of seating capacities.

99 STEEL FLOORING INSTRUCTIONS

William F. Klemp Co.—offers its 1949 edition of a new technical manual entitled, "Instructions for Laying Klemp Hexteel and Floorsteel." Hexteel heavy-duty surface armor is an open-steel grid, solid, enduring and self-anchoring. Floorsteel, flexible floor armor is an open steel mat. Both are used to armor and reinforce bridges, docks, air landing strips, loading platforms, industrial floors, heavily traveled highways and catalytic cracking units. The book contains complete engineering data.

100 STEEL SHEET PILING

Carnegie-Illinois Steel Corp.—A 56-page booklet gives detailed discussion of the uses, characteristics, and assembly of the three general types of steel sheet piling sections; the straight web, the arch web, and Z-piles. Following this discussion are complete tables of wall dimensions, cellular structures, accessories, and weights for all sections, plus diagrams of the individual sections, walls, corners, cellular structures, cofferdams, bulkhead and piers, and caps or copings.

101 STRUCTURAL ARC WELDING

Lincoln Electric Co.—A series of single sheets, punched for loose-leaf binding are sent free periodically to structural engineers and architects. Studies are presented of actual applications of structural welding as well as theory of design. Current series of sheets gives methods of analyzing and calculating loads on welded rigid frames of various spans and types.

102 STRUCTURAL SHAPES

Carnegie-Illinois Steel Corp.—Attractive 72-page book, "Hot Rolled Carbon Steel Structural Shapes," contains complete properties and dimension tables of all available structural shapes, including diagram drawing of each. Also includes plate size limitations and basic structural data on bearing piles, steel sheet piling, floor plate, crane rails, and corrugated sheets.

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TIDE GATES

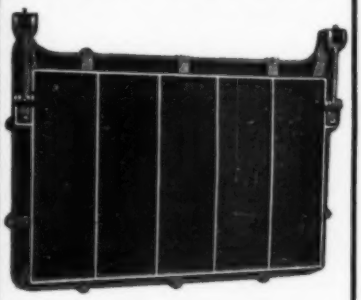

Fig. B-61. Type M-M

Type M-M (Rectangular) Tide Gates are available in 37 sizes from 8" x 8" to 96" x 96". Bulletin No. 71 describes them fully.

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CATALOG DIGESTS

103 SUMP PUMPS

Economy Pumps, Inc.—Construction details, applications, and detailed installation drawings of Economy VSL and VS general service sump pumps are featured in a new catalog. These pumps are suitable for automatic drainage of pits, basements, and similar constructions. A selection table for specific application of pumps, ranging in capacity from 30 to 150 U. S. gal per min is contained in Catalog No. E-748.

104 SURVEYING ALTIMETER DEVELOPMENT

American Paulin System—offers their interesting and instructive publication entitled "Origin and Development of the Barometer and Altimeter." This booklet will acquaint civil and field engineers with the basic differences between their system of instrumentation and all other types in the field of surveying altimeters.

105 SURVEYING INSTRUMENTS

C. L. Berger & Sons—Catalog "F" describes the full Berger line of transits, levels, theodolites, alidades and special instruments made by that company for 80 years. A well illustrated brochure (N 648) is available on request for preliminary information.

106 SURVEYING INSTRUMENTS

David White Co.—40 pages of detailed information on instruments for engineers, surveyors and builders is available. Bulletin No. 1050 is profusely illustrated with the various types of transits accompanied with their specifications, levels, alidades, plane tables, tripods, tapes and surveying instruments for all purposes. A price list applying to the instruments discussed is included.

107 SURVEYING INSTRUMENTS

Norbert Dienstfrey—A series of five booklets covering the Hammer-Fennel auto-reduction tacheometer, light dumpy levels, precise levels, 4 in. transit and the 5 in. precise transit are offered free. The instruments are lightweight, totally enclosed, climate-proof and ideal for every type of construction work.

108 SWIMMING POOL EQUIPMENT

Permutit Company—Complete information and specifications are contained in Bulletin 2157 on Permutit recirculation and purification equipment. This includes information on alum and alkali feeds, filters, rate of flow controllers, automatic pH controls, chlorinators, test kits, suction cleaners and zeolite water softeners.

109 TIDE GATES

Brown & Brown, Inc.—Bulletins 69 through 73, 75 and 76 describe various types of tidal gates, both circular and rectangular, and give authentic information regarding head losses.

110 TRACTOR SERVICE MANUAL

Allis-Chalmers Mfg. Co.—A 220-page service manual featuring HD-5 crawler has just been released. A general description of the tractor, complete specifications and a detailed pictorial and written description of the various assemblies of the machine, as well as instructions for the proper adjustments and repairs when rebuilding these assemblies are included. This book is priced at $3.00.

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111 TRANSITE PRESSURE PIPE

Johns-Manville—115 pages of information covering the whole job of installation from receiving and handling the transite pressure pipe to pressure and leakage tests of the finished line. The subjects range from excavating the trench, through various steps of pipe-assembly to backfilling and tamping. There are over 100 line drawings illustrating important operations.

112 TRUCK LOADER

Barber-Greene Co.—8 graphic, 2-color pages describe heavy duty pneumatic-tired loaders with hydraulic trimmer. Bulletin 543-4 outlines every type of application in thumbnail perspective drawings. Close-up photographs give that important "factory" look inside at exclusive advantages built into the loaders. A catalog of accessories suggests other applications. Copy is concise and informative.

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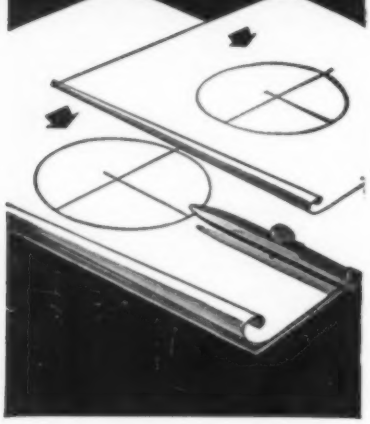

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CATALOG DIGESTS

113 1950 TRUCKS

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114 TUNNELING

Commercial Shearing & Stamping Co.—Now available is a text book on tunnels and an introduction to tunnel geology by tunnel men. Entitled "Rock Tunneling with Steel Supports" by Karl Terzaghi, the book deals with specific information on tunneling, covering 300 subjects. The most comprehensive book of its type ever offered to the tunnel builder and designer. Price $2.50 per copy postpaid.

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115 UNDERWATER SURVEY INSTRUMENT

Bludworth Marine, Div. of National-Simplex-Bludworth—A brochure describing the Model ES-123 supersonic echo depth recorder and its application is offered. Survey groups and others engaged in dredging, excavation, and various silt studies will find this underwater survey equipment most interesting. The instrument provides a permanently recorded graph of underwater contours as well as the consistency of bottom materials. Price: $3,300 and up.

116 VENTURI METER

Simplex Valve & Meter Co.—Bulletin No. 400 describes in detail the operation and installation methods of the type H meter register. This is a circular-type chart instrument equipped with various forms of mountings and arranged for operation under the majority of hydraulic head conditions. A complete pipe size and meter capacity table provides a quick and ready reference when needed. This bulletin is of essential interest to any filter plant or sewage plant designing engineer.

117 VERTICAL BOOM DITCHER

Barber-Greene Co.—offers Bulletin 44C, an 8-page 2-color brochure illustrating and describing the more than a quarter century of preference for the crawler-mounted Model 44C ditcher. Advantages of the exclusive vertical boom are defined. A wide range of proven application is shown. Attention is called to the most important mechanical features of the 44C shown in photographs.

118 VIBRATORS

Viber Co.—New applications and equipment development on interchangeable vibrator units, flexible drive, full depth internal concrete paving, rubber-tipped and Model PX-6 external vibrators are described in a recently published catalog. Specifications concerning speeds, weights, sizes, types of power, etc., are included.

119 WASTE TREATMENT

American Well Works—Manual No. 149 titled "Modern Processes and Equipment for Sewage and Industrial Waste Treatment" has been published. The 24-page book crystallizes the approach to modern waste treatment methods and equipment with illustrations and descriptions. A new 8-page Technical Supplement "CR" on Grit Removal by Velocity Regulations is also offered. It illustrates and explains the latest development in Camp Grit Chambers.

120 WATER CONDITIONING DATA BOOK

The Permutit Company—has compiled a data book which includes complete information and tables on: Hydraulics; hardness of water; chemical conversions; coagulation; acid and alkali dosages; chemicals used in water treatment; sodium chloride solutions; Zeolite, Zeo-Karb H and De-Acidite reactions; Hot Lime Soda Process, sodium sulfite, ferrous sulfate and phosphate dosages; boiler feed makeup; saturated steam; temperatures; pH values; solubility of oxygen and air, etc. The new edition of this Data Book is practically a necessity to practicing engineers interested in water conditioning problems!

(*Continued on page 104*)

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121 WATER FILTERS

Proportioneers, Inc.—Bulletin 1800 describes Pur-O-Cel Diatomite filters for use in filtration of water in municipal and industrial water works and in swim pool recirculation systems. Engineering data on the application of these filters, including specification and dimensions covering the complete recirculation and purification systems, are given.

122 WATER FLOW MEASUREMENTS

Layne & Bowler, Inc.—A handy pocket-sized booklet entitled, "Measurement of Water Flow Through Pipe Orifice with Free Discharge," has been revised and reissued. Forty fact-crammed pages explain the Layne pipe orifice meter method of computing water flow. It tells how to use it, how accurate it is, gives flow graphs for various size pipes and explains the method of computation.

123 WATER POWER EQUIPMENT

Newport News Shipbuilding & Dry Dock Co.—An exceptionally attractive book, consisting of 75 pages, is offered free of charge to engineers interested in hydraulic turbines, butterfly valves, pressure regulators, penstocks, regulating gates and trash rakes. The booklet shows various plants throughout the United States using this equipment. Pictures, details of the development, sectional views, and an interesting synopsis of the company's hydraulic laboratory are included.

124 WATERPROOFING AND WEATHERPROOFING

Western Waterproofing Co.—Specifications and advantages of Ironite for protection against subsurface water damage are briefly described along with Parge, which is used for protection against interior wall dampness. Where to use these products and how to specify are thoroughly covered.

125 WATERPROOFING—INTERIOR & EXTERIOR

Western Waterproofing Co.—Parge for interior surfaces and Dilato for exterior joints are discussed in a 4-page 2-color folder. What is Parge and its advantages are discussed. Dilato is also covered and accompanied with diagrams.

126 WELLPOINT SYSTEM

Moretrench Corp.—"Working in the Dry with the Moretrench Wellpoint System" is the title of a 64-page catalog describing and illustrating the Wellpoint system and its use in dewatering various types of construction projects. It is amply illustrated with on-the-job photos.

127 WELLPOINT SYSTEM

John W. Stang Corp.—A new catalog on Wellpoints is being issued. It contains illustrations and descriptions of many dewatering jobs. The booklet shows the use of Stang methods and equipment employed in small and large projects.

128 WELDED FABRIC

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—A 2-color folder describes Clinton electrically welded fabric which has been successfully applied to every form of reinforced concrete construction. Some of its many uses are for concrete roads, streets, airports, floors, pipe, sewers and reservoirs. Structural advantages, ease of use and standard styles are listed.

129 WIRE ROPE

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—The new Wickwire rope catalog offers a different approach to this difficult subject. Charts, tables, drawings, and photographs were included to present a fresh slant on wire rope. The catalog covers the characteristics, care, handling and describes wire rope for specific industries.

130 WIRE ROPE—LIFE AND COSTS

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—Thousands of wire rope users—old hands and new—have found "Know Your Ropes" of inestimable value in lengthening life of wire rope. Contains 78 "right and wrong" illustrations, 41 wire rope life savers, 20 diagrams, tables, graphs and charts.

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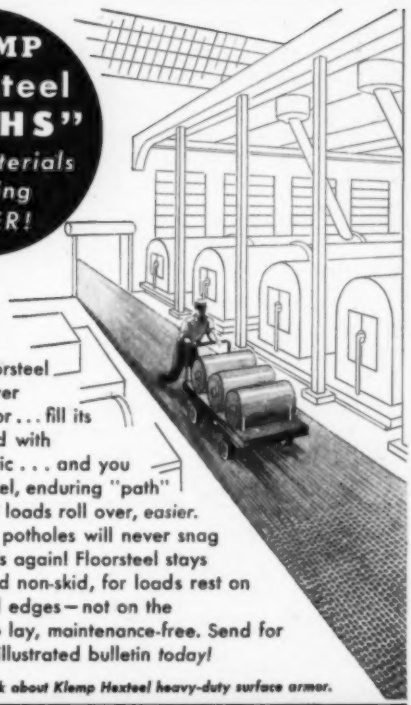

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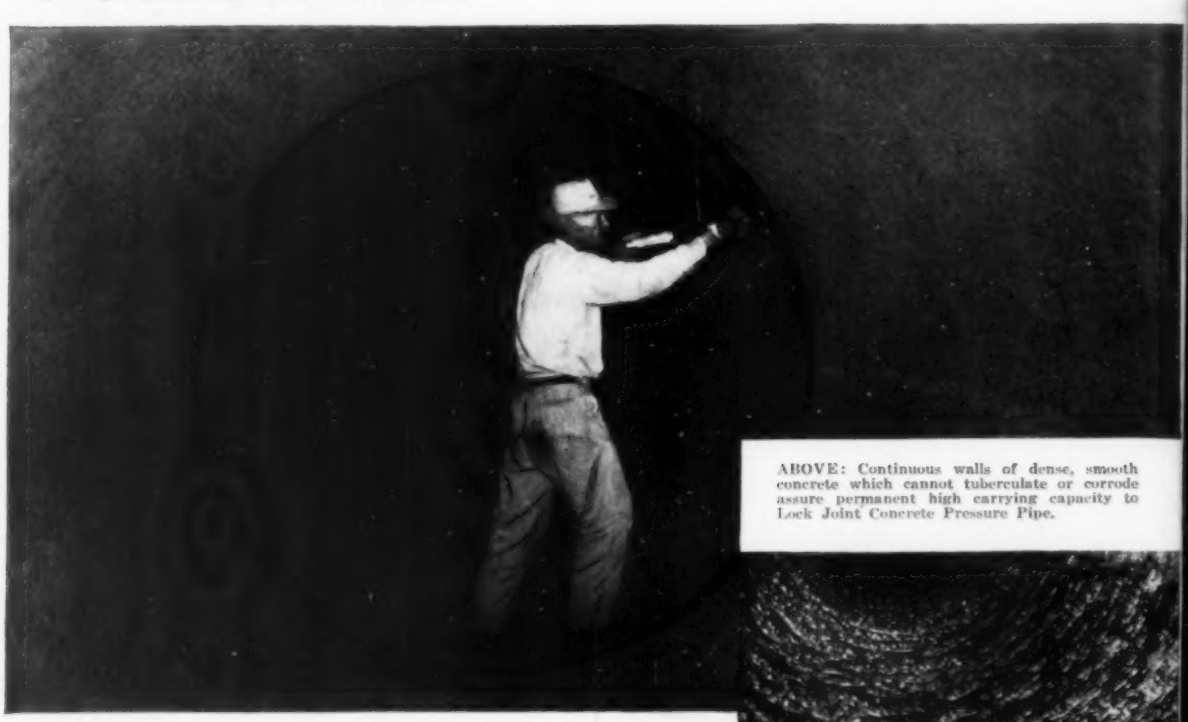

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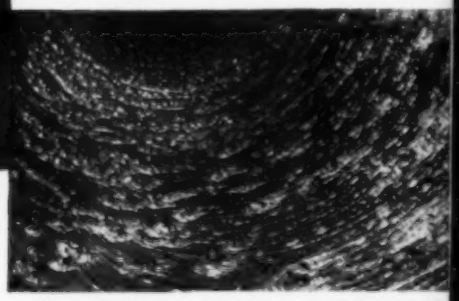

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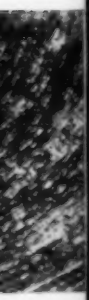

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